PERFORMATIVE DIGITAL ASSET MANAGEMENT

To propose a framework and proof of concept model that effectively enables researchers to document, archive and curate their non-traditional research data

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Keywords

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Statement of Original Authorship

The work contained in this thesis has not been previously submitted to meet requirements for an award at this or any other higher education institution. To the best of my knowledge and belief, the thesis contains no material previously published or written by another person except where due reference is made.

Signature:

Date: 1/06/2015

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Abstract

My study is cross disciplinary and was conducted as two research and development projects for the Doctor of Creative Industries (DCI) program presented at the Queensland University of Technology. The first research project (DCI Project 1), *Performative Digital Asset Management Part 1: "A Moment in Time"* (Nel 2012), used knowledge gained from Information Communications Technology scoping projects, and the analysis of research data from the Creative Industries Faculty submission packages for the 2012 Excellence in Research for Australia (ERA) initiative of the Australian Research Council. The research conclusions involved the explication of a theoretical model, with active temporal and spatial elements, that could represent creative practice-led research journeys. This model was called the *Hybrid Publication Model*. The second research project (DCI Project 2), which I presented in my second milestone seminar as *Performative Hybrid Publication: "Articulating 21st Century Research Outputs in the Creative Industries"*, is a further development of the conceptual model arrived at in DCI Project 1. In the constructing of DCI Project 2, I undertook a proof of concept of the model theorised in DCI Project 1. The working proof of concept model that emerged from this process demonstrably allows researchers to document, archive and curate their non-traditional research data. Effectively, the model became an interactive creative-practice research tracker. The cyclic development and experiments that I undertook in creating the model are informed by social scientific concepts, and, more specifically, studies that examine journalism approaches to 'objectivity' and 'truth' in news gathering and presentation. I adapted these approaches to the particularities of performative, practice-led research, to inform the model's development. The model incorporates the spatial, temporal and visual elements of Creative Industries (CI) performative research approaches with mainly non-traditional research outputs (NTRO). It provides a strong new approach to performative research practice and review within the Creative Industries.

Research Objective

To provide a proof of concept model that can document and map creative practice-led research projects where the outcomes can be characterised as non-traditional, and to situate such a model within a framework that can provide the rigour that both identifies and enhances the scholarship associated with creative practice-led research.

Prologue

Before the construction of modern and contemporary cities, when the human race was still young, people started to develop a sense of artistic display and documentation. Ancient humans produced rock paintings from which we can decipher their actions and imagine the landscape and its abundance. Early forms of writing and ancient hieroglyphics provide historic accounts of the great pharaohs. In ancient tablets and scrolls, we can see, through the eyes of the discoverer, the first notations of music. Depictions of life form and action were captured in sculpture and on canvas, and now are rediscovered through archaeological exploration. All these things are possible because of tactile manifestation and evidence of historic artefacts that were created to capture a moment, document an event or celebrate significant figures or discoveries. These tactile artefacts can be found and studied and represent important criteria for the preservation of knowledge and/or the creation of memory.

Prior to the introduction of the written word and its dominance in the documentation and articulation of events, knowledge was also disseminated through oral, aural and visual means, sometimes through dramatised or ritualised events. The new predominance of the written word in countries now better known as "the developing world" superseded performative and visual communication as a means for disseminating and preserving knowledge. The role of dramatised communication was consigned to the field of the arts, where it was considered an insight into life or pure art form. However, the previous role of recording, communicating and providing a central meaning to life has progressively shifted into the fields of technology. This is very noticeable since the development of digital technologies, prominent since the early 21st century. Today, we write digital documents, and look at the "rock paintings" that record our history in the making, in high definition on digital displays. We record the highest quality of sound in the digital realm, and capture countless digital images. All these digital artefacts appear in great numbers but can disappear just as rapidly. The possibilities for embracing the change to digital technologies in the conduct of creative industries teaching, learning and practice-led

research, was a central pre-occupation for me when I started at the Creative Industries Faculty of QUT in 2007.

Such digital outputs and records produced with creative or documentative intent are "everywhere and nowhere" as we—consumers and producers, researchers and chroniclers—capture, in digital format, but strain to retain, identify, preserve and deliver, that which is today's present and tomorrow's past. Consequently digital media elements are often used by creative practice-led researchers to articulate their creative practice research journeys.

Part 1: BACKGROUND & INTRODUCTION

1.1 BACKGROUND

As Technical Services Manager for the Creative Industries Faculty (CIF) at the Queensland University of Technology (QUT) in Australia, I manage technical support groups and facilities using applied technologies in specialist and simulated environments that include Industrial and Architectural Design, Journalism, Media and Screen Arts, Music and Sound, Theatre and Performance and Visual Arts. I maintain my own personal practice as a Theatre Technologist, Television Director, Musician, Recording Engineer and Applied Technology Consultant for technical developments of the Creative Industries. Lately, I also navigate a newly defined third space where I have to function as technologist, artist and researcher, wedged between the world of academia and professional practice. The need to firmly step into this third space had practical beginnings.

1.2 INTRODUCTION

The "all that is old is new again" realisation outlined in the prologue had sparked me to ponder anew how we could: harness the challenges of the digital age, to promote and enhance performative work rather than have digital diminish our access to the things that we created because our systems were inadequate to the storage and retention of such material. The manifestation of such a "digital remembering" within the Creative Industries Faculty (CIF) required a sound conceptualisation to ground further research and development work to allow for: the better management of the rich media assets that were central to the teaching, showcasing and research interests pursued by the Creative Industries Faculty of QUT.

This issue had become urgent because of the rapid development of a digital world that was becoming increasingly central to the activities of industry and the wider society.

In a major digital intensification, the universal, digital multi–media distribution mechanism YouTube was established in 2005 and was acquired by Internet giant Google the following year. These twin developments provided a social media market platform that penetrated the communications approaches of all industries, including the tertiary education sector. Such changes quickly integrated non-traditional and performative research approaches with the technical sphere that I occupied as manager of Creative Industries Faculty Technical Services (CIFTS). Such a rapid transformation of both spheres led me to contemplate the possibility that, in some cases, the technical and the academic could become inseparable. As a result I had to position myself inside the academic realm, a place hitherto auxiliary to my operational responsibility. This bringing together of the technical and the academic provided the conceptual backdrop to the development of my model for research gathering, analysis and presentation for peer review.

As a result, the final presentation of my two DCI projects is delivered as a doctoral package with a mixed range of features, including a written narrative with live presentation, modelling, visualisation and documentative aspects. All these things are positioned to form a single entity that represents this DCI interdisciplinary research study series[1]. I use the word "series" because this document is essentially the concluding chapter that brings together the lessons from the discrete yet interrelated DCI Project 1 and DCI Project 2.

DCI Project 1 primarily focussed on the notion of a DAM (Digital Asset Management) system and the process towards publication for creative practice-led researchers (creative practitioners) who used media elements to articulate their research outputs and in particular, the digital media packages composed for the ERA process. The particular conceptual and research focus that I developed during DCI Project 1 informed and adjusted my professional understandings towards the ultimate conclusion of this project, the conceptual model that I term the Hybrid Publication Model which advances on a text model through introducing rich media elements as creative and documentative events The further conceptualisation of this model led

[1] The DCI usually comprises coursework and two research projects examined internally and externally under the guidelines of the ARC.

me, in DCI Project 2, to experiment with and develop a multimodal and dynamic Hybrid Publication Model that represents the creative practice-led research journey. In essence, DCI Project 2 builds on DCI Project 1 in two important ways. Firstly, it provides a more sophisticated conceptualisation designed to theorise a more academically robust approach to NTRO development, analysis and publication. Secondly, it develops a prototype that facilitates such academic principles and requirements. To reach such an end result, the second part of my academic journey, DCI Project 2, proceeds in the following way. The particular notion of provenance (a suitable measure of academic rigour) suited to CIF NTRO research work is developed and explicated through a theorisation of the term "augmented web of facticity". I then model the identification and delivery of research work adhering to base elements of attributed evidential trails with temporal and spatial positioning to establish provenance. Through this means, the journey of performative research is accessible to the creative practice-led researcher and peer reviewer.

This exegesis, the conclusion of my DCI journey, does not present a full report of both research projects, but rather summarises the central path of the research journey before presenting conclusive critical reflections. The document considers the conceptual notion of a Hybrid Publication Model, describes the journey to the making of a proof of concept model, and articulates this DCI research series in terms of Performative Digital Asset Management.

In the exegesis and the presentation, I have included evidential elements that were used in milestone seminars that marked the end of each research project. The document concludes with a critical reflection that provides a combination of reflective views, implications and recommendations borne from observation of and participation in research practice by creative practice-led researchers. This exegesis and its appendices thus provide insights into how professional practice and academic rigour were brought together in the completion of my DCI course. The final presentation will demonstrate, explore and give substance to the DCI journey that is discussed in this exegesis.

Part 2: RESEARCH APPROACH

2.1 RESEARCH PRINCIPLES FOR DCI PROJECTS 1 & 2

In many ways DCI Project 1 informed DCI Project 2, in that the research journey distilled overarching principles that applied to both research projects. The academic coursework that accompanied my DCI helped me to conceptualise my position within this emerging field and to establish my overarching approach to my two projects. For me, the reading and reflection conducted as part of my DCI coursework established my research approach as *ethnographic*. With reference to a particular *ethnic* group, I needed to construct a problem through a lens that combined two contrasting perspectives: that of an *emic* (the "insider's" various points of view) and the *etic* (a more distant, analytical orientation) (Hoey 2005). Within this framework, I identified two distinct dimensions of engagement that informed the particular research focus in my two DCI research projects. These dimensions are "passive" and "active" research engagement that I discuss in section 2.3.1 and 2.3.2.

During the two research projects, when I set out to solve a problem or refine towards a further iteration (such as in the making of the models) I consistently decided on a recognisable pathway that started with an idea that I then explored and, through a cyclic process of reflection on action, refinement and adaptive change, the pathway ultimately led to a proof of concept or the achievement of a set goal. Such a pathway is similar to the three-point structure found in academic writing:

Point → Evidence → Relevance. It can be, and in many cases is, a repetitive cycle (cyclical) as I indicated above.

The images (figures) below set out the core of the research approach for both my DCI research projects. A particular position, anchored in the ethnographic positioning, is enhanced by activity/methods that I describe in the language of my site and field as "active" and "passive". In the end this approach presents a cyclic

process of development with periods of reflection upon action, which lead to further development and eventual outcomes.

Figure 1: Screenshot from milestone seminar presentation: Research approach for DCI study series

2.2 POSITIONING

Overall my research is multifaceted, with the researcher alternating between being positioned as the insider and outsider. Other scholars have applied this thinking to cultural investigation (Morris et al. 1999) or to the design field (Dourish 2006).

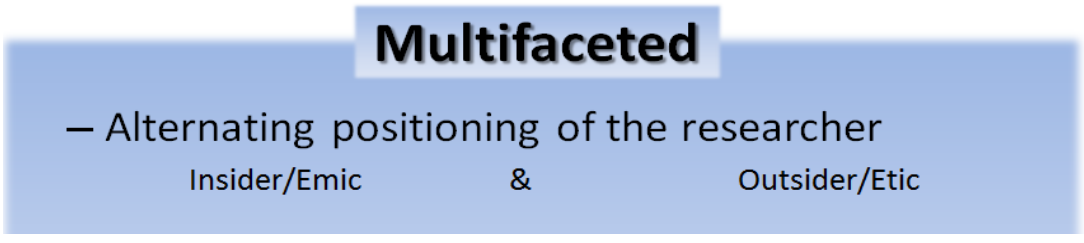

Figure 2: Partial screenshot from milestone seminar presentation: Researcher positioning

2.3 DIMENSIONS OF RESEARCH

In both DCI research projects, passive and active dimensions of engagement are used in the gathering of information and research data.

Figure 3: Partial screenshot from milestone seminar presentation: Dimensions of data gathering

2.3.1 Passive Research Engagement

In a purely academic sense, passive research might occur during background research towards the establishment of a literature review and, ultimately, a research question or, as in my case, a research objective. Passive research is therefore a process involving thought and reflection. In the more active persona of the DCI practitioner this can mean trying new approaches to a problem, reflecting on the outcomes and incorporating knowledge from such outcomes into a more systematic approach. This approach involves some doing, and is potentially cyclical, involving reflection on particular outcomes. In passive research such knowledge is, however, crystallised and abstracted in a form that can contribute as a source for future research and development.

An example can be drawn from my DCI Project 1 work, where information and writing from the field are examined in conjunction with reflection and reports on professional practice towards shaping future, more active, research and development contributions. Such a process I undertook when working on the Creative Industries Digital Infrastructure Development Project (CIDI, now QUT Media Warehouse).

I led this project for the Creative Industries Faculty of QUT to develop a business case that led to a proof of concept for a rich media repository and digital asset management system. I provided collaborative support to the university project team that proceeded to implement this digital repository university-wide.

CIDI was officially launched on 5 October 2012 within the university as the *QUT Media Warehouse*. In terms of a passive research contribution to my work such projected research and development informed both DCI Project 1 and DCI Project 2.

Before engaging with the CIDI project in 2008, my knowledge base and practical competencies did not include enterprise-level ICT infrastructure and systems. My professional positioning as both the emic and the etic in relation to the development of advanced digital infrastructure instigated both a conceptual and competency leap that provided the background to the digital asset management approach that, effectively, underpinned the journey through my two DCI projects.

2.3.2 Active Research Engagement

In my active research engagement, I made use of traditional academic research methods, such as structured and semi-structured interviews of academic and technical support staff, to collect data and to critically analyse and interpret the outcomes. In DCI Project 1, such work provided the framework for a research and development solution to the need for better research gathering, analysis and reporting approaches for NTRO in the Creative Industries. Such data indicated the need for a second phase development that, through a cyclical experimental process, could generate outcomes or conclusions.

2.4 CYCLIC PROCESS OF DEVELOPMENT

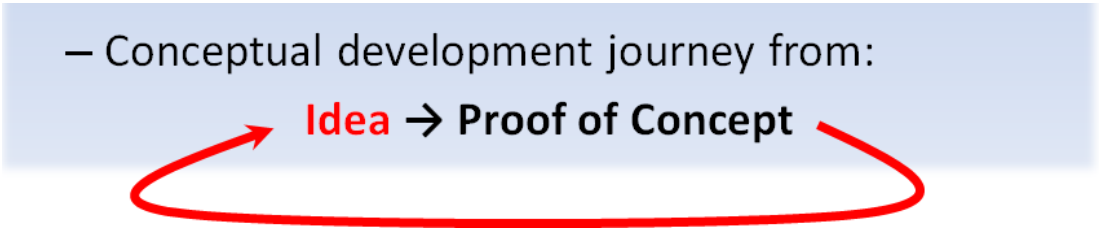

Figure 4: Partial screenshot from milestone seminar presentation: Conceptual development cycles

The image below shows the cyclical sequence that underpins each individual project, and indeed, the entire research series. Both DCI Project 1 and DCI Project 2 use this cyclical process in the creation, production and eventual delivery of an outcome.

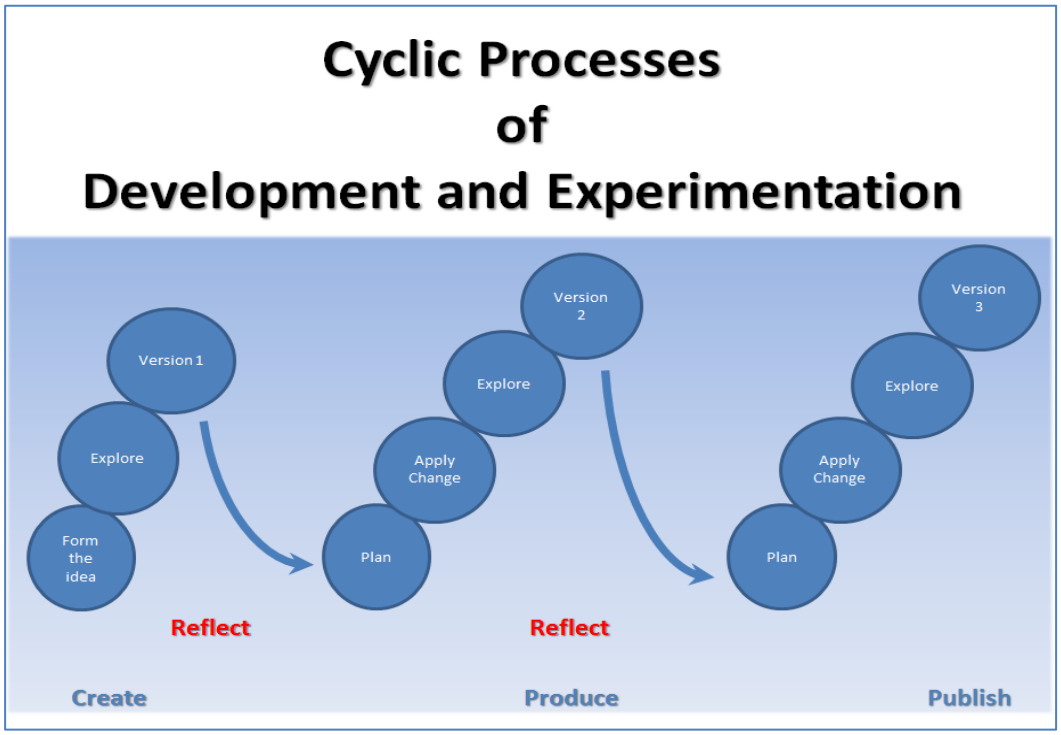

Figure 5: Screenshot from milestone seminar presentation: DCI cycles of study series

This is a recognised process of research and development. Through such an approach, my DCI Project 1 established that within the community of Creative Industries practitioners and academics the skill to create, care for, or manipulate content was ill-defined and not sufficient to allow for a community understanding as to what might constitute a "scholarly" multimedia input. I concluded, consequently, that such a "benchmark" required approaches that demonstrated considerable academic rigour and that could, simultaneously, provide the systems needed to publish the resultant academic publications to acceptable academic standards.

Part 3: DCI PROJECT 1 OUTCOMES

In DCI Project 1, I conceptualised the Hybrid Publication Model as a means through which the publication of rigorous non-traditional academic work could be established. This conclusion sparked the decision to launch a second project that could systematically capture the components of a performative Hybrid Publication; allow for their integration; provide a mechanism through which such data could be integrated into high-standard research outcomes; and make such outcomes available for peer review. The key outcomes from project one informed the further conceptualisation, and subsequent actualisation, of a system and method for gathering and delivering disparate NTRO research material, as described below.

3.1 ARTICULATING THE PUBLISHING PROCESS FOR NTRO

DCI Project 1 revealed that CIF researchers commonly use multimedia elements to create and document their research and that they adopt a four-step process towards publication that I set out here.

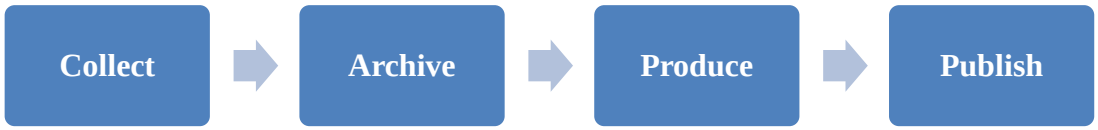

Figure 6: Publishing process for research with NTRO

3.1.1 Collect

This process collects NTRO—including audio, image, video and text (rich media objects)—that can serve as evidence of research. Examples of these can include, but are not limited to, video files of performative action, images of an exhibition, text about the research, research statements, and written papers.

3.1.2 Archive

All collections (of NTRO) need to be placed somewhere for safekeeping, accessibility and further research activity such as the QUT Media Warehouse.

3.1.3 Produce

This process assembles information and records of NTRO (evidence) in a tailored poetic fashion (in this instance "tailored poetic fashion" is represented by the making of a digital package.) to represent the sample for review.

3.1.4 Publish

After review, non-traditional files are "published" as research through a range of multimedia packages.

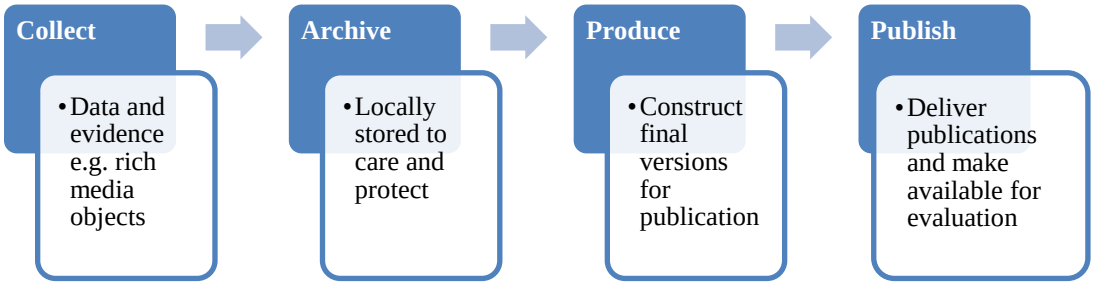

Figure 7: 2012 Workflow of a basic ERA submission of NTRO as a package

DCI Project 1 moved through this approach to examine the development and presentation of packages for Excellence in Research for Australia (ERA)[2] at CIF, a process that followed the above workflow to present research for peer review. In this way and in the terms of the overall DCI project, such ERA-based project work served as a catalyst for a more broadly-based examination of representing performance-based research through capturing a particular research project as a

[2] Excellence in Research for Australia (ERA) is an initiative for evaluating research in Australia. Established in 2008 with a first trial in 2009, ERA replaced the Research Quality Framework (RQF) (Allport 2008), and is a quality assurance assessment method within the 41 participating higher education institutions of Australia. ERA uses a combination of performance indicators and expert reviews facilitated by committees made up of internationally recognised experts. The information released from ERA is important as a benchmark and qualitative external evaluation and has funding implications for the participating institutions.

"snapshot" or moment, as reflected in the project title: *Performative Digital Asset Management Part 1: "A Moment in Time"*. The central conceptual outcome from the ERA research is the emergence of the Hybrid Publication Model, which I document as a new emerging paradigm in DCI Project 1, as explained in the summary below.

3.2 THE CONCEPTUAL HYBRID PUBLICATION MODEL

The concept of the Hybrid Publication Model is the theme around which the research series now centres, and as such, this aspect of DCI Project 1 constitutes original knowledge.

The term "hybrid" here describes a situation where different aspects or components are combined to form something new. In the context of this project, Hybrid Publication has its origins in the practice of the documentation of research with NTRO. My research about the ERA 2012 submission by CIF found that researchers gathered data through the use of elements that include but are not limited to: text, audio, images, sketches, notes, blogs or videos. For example, a researcher might take photographs and video during a theatre rehearsal. Such plans, records and even some of the performative scenography will constitute digital elements of the ultimate research output[3].

The first step towards the production and visualisation of a Hybrid Publication Model is the representation of a timeline with definable start and finish points (temporal demarcations). For example, a 12-month project might begin on January 1 and finish on December 31. Such a timeline can represent the operational spine of a research project, as represented in the illustration below.

[3] For the purpose of my study and from local practice it is assumed that all records are kept in digital format.

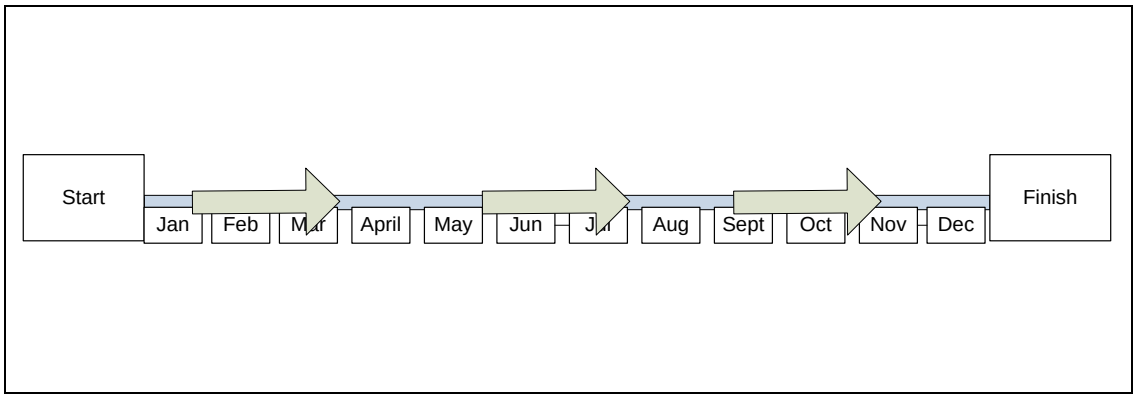

Figure 8: Project timeline

Along this timeline we find action, events and happenings, as indicated by the vertical lines in the diagram below.

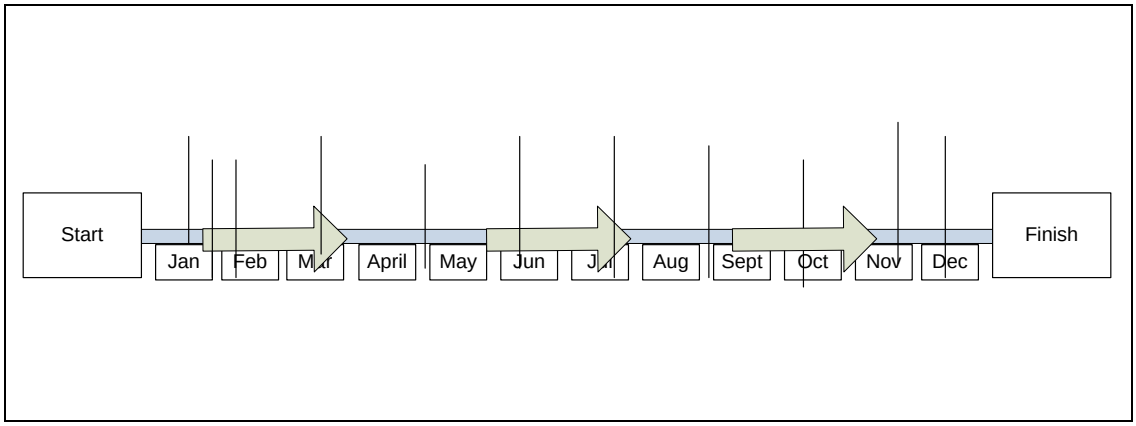

Figure 9: Events along the timeline

Simultaneously, or sequentially, over a period of time as NTRO occur, we find, hanging from this spine, elements of evidence in the form of audio, image, text and video. These I represent in *Figure 12: The theoretical Hybrid Publication Model* with a set of rich media indicators:

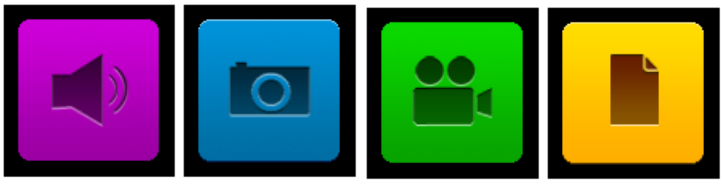

Figure 10: Rich media indicators

The various multifunctional aspects of these elements can evidence factors such as occurrence, depth of knowledge, and demonstrated levels of a particular understanding. But these media elements are not the only sources of such evidential and representational data. For example, today we can also reference a website as a place of occurrence, and on a website one might find some of the rich media elements again as attributes to the output.

Website

Figure 11: Hybrid Publication Model website indicator

A 'mind image'[4] of such a collection is represented in the diagram below. Here, the central spine is not only a time of duration indicator, but holds the core message of the research or, in other words, the research statement. The protruding depictions of events and representations are graphically represented by flags. The diagram below, then, is a first depiction of the Hybrid Publication Model:

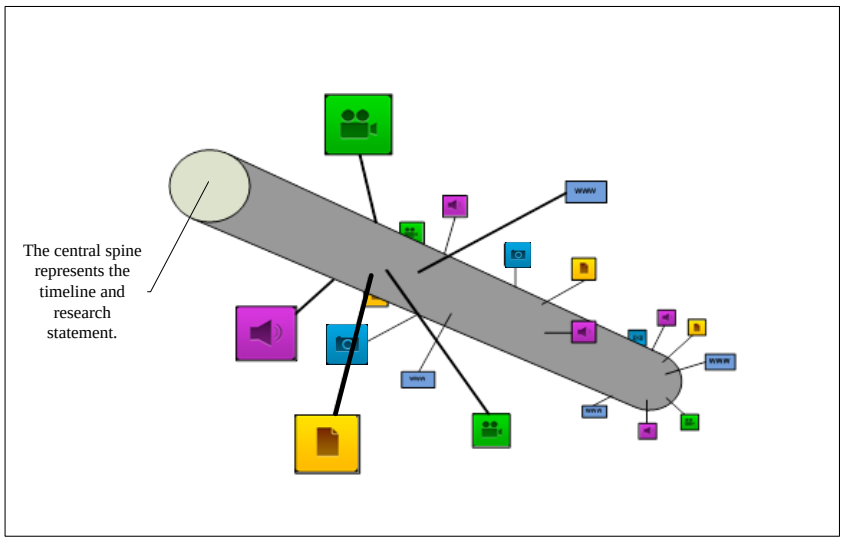

Figure 12: The theoretical Hybrid Publication Model

[4] Mind image – What I thought the Hybrid Publication Model looked like

In a linear representation, the following graphic places the Hybrid Publication in a format that includes a research statement and other evidence.

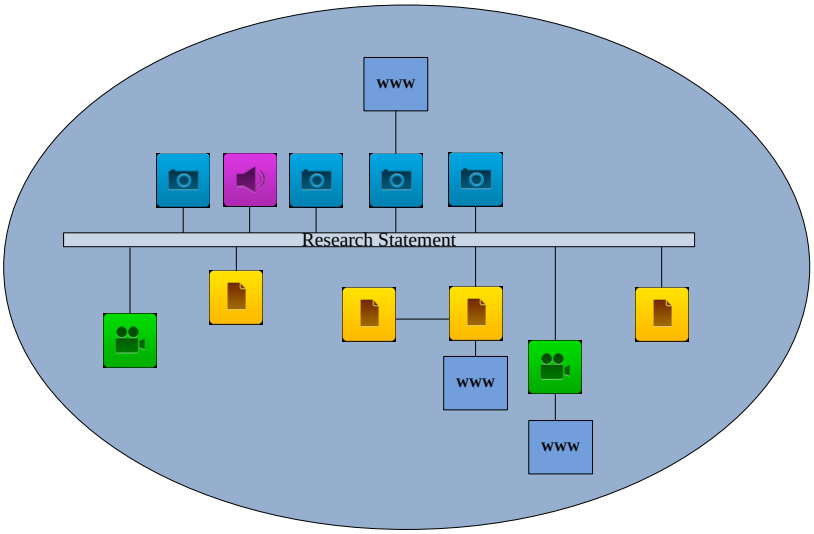

Figure 13: The theoretical Hybrid Publication Model in linear representation

If and when this collection is used to demonstrate the research as a whole, we can label it as a Hybrid Publication. In submissions that QUT published as part of ERA since 2009, the three-part publication included a research statement and evidential representations, consisting of all the basic elements of rich media: audio, image, text and video.

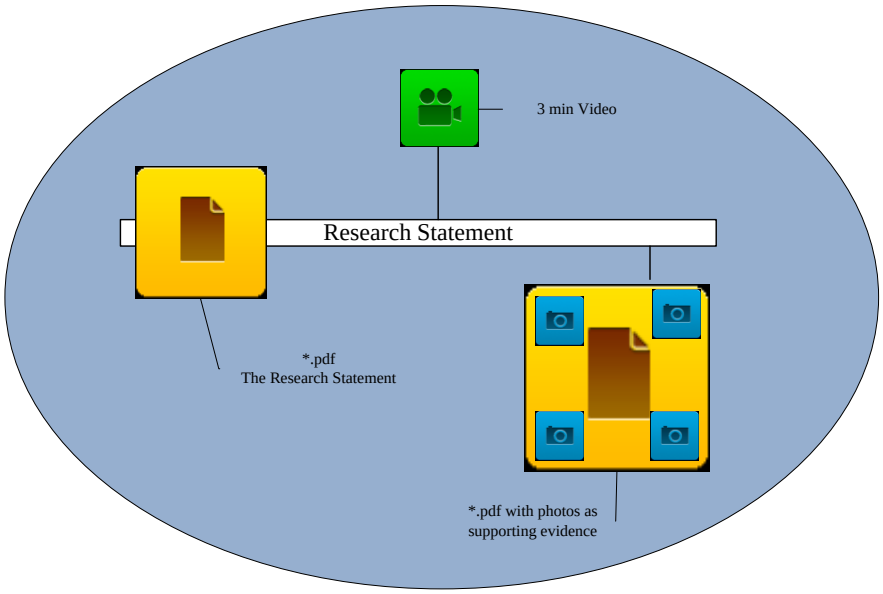

Figure 14: The base ERA package (ERA Hybrid Publication)

In the CIF ERA submissions, the media-rich submissions do a particularly good job of articulating the work of various CIF researchers. These packages become, in many cases, a visual reference of the research work conducted but cannot represent the full range of activities that, ultimately, produced it.

However, the notion of the hybrid publication provides us with key pieces of information. Every research project has a timeline. This timeline is linear sequential. Every research project also has a research "evidential forensic timeline". This timeline is the documentative record (evidential trail), which often presents as rich media elements, and is used to articulate the work of the creative practice-led and performative researcher. In effect, these elements are a type of attribution to the project. Hence, rich media elements can be counted as NTRO. Key events, places and activity are part of the recorded Hybrid Publication. Timelines are represented in research statements, which means that the timeline and research statement, at one and the same time, become the spine of such a publication. With this understanding I have framed the paradigm that I name the Performative Hybrid Publication. This paradigm becomes the central focus in the conclusion of the study series.

Part 4: DCI PROJECT 2 OUTCOMES

The model produced by DCI Project 1 fed directly into DCI Project 2, which is the principal focus of the remainder of this exegesis and my presentation. The remainder of the document includes a more detailed description of the theories and developmental process that brought me to the proof of concept model that effectively enables researchers to document, archive and curate their non-traditional research data. To meet this challenge I propose one model of practice that researchers in the field of creative practice research with mainly NTRO can follow. The secondary outcome sought in making such a model is found in the following question: "Can such a model discipline the way that researchers manage, report and articulate their research and so improve the peer review protocols that apply to such research?"

To shape the more precise conceptualisation that such a model would require, I developed a theoretical framework to more adequately capture the depth and sophistication of creative practice-led research with mainly NTRO.

4.1 DEVELOPING THE PRINCIPLES OF HYBRID PUBLICATION

As stated earlier in this exegesis, the second project builds on the first in two important ways. Firstly, it provides a more sophisticated conceptualisation designed to theorise a more academically sound approach to NTRO development, analysis and publication. Secondly, it develops a prototype that allows for the exercise of such academic principles and requirements.

To reach such an end result, the second part of my academic journey—DCI Project 2—proceeds in the following way. The particular notion of provenance (a suitable measure of academic rigour) suited to CIF NTRO research work is developed and explicated through a theorisation of the term "augmented web of facticity". I then model the identification and delivery of research work adhering to provenance that, through this means, is accessible to the creative practice-led researcher.

The conceptual superstructure of the Hybrid Publication paradigm is established by the following three principles:

1. The existence of the "Augmented Dimensions of Facticity",
2. The presence of fully documented evidential elements with attributions of time and space, and
3. The establishment of Provenance through the above-mentioned means.

4.1.1 The Augmented Dimensions of Facticity

I have adapted my modelling to establish these principles through applying the journalism theory of the levels of inquiry, a theory developed to overcome a similar conceptual problem within the field of journalism. Journalists must construct a story or artefact that accommodates the temporally constrained need for basic comprehension of an issue: news is current. For comprehension, news (and indeed any complete narrative) must contain six elements: "who, what, when, where, why and how". In the reporting of news, initial accounts, such as a story of ongoing flooding, are necessarily superficial. However, subsequent accounts that might extend across days, weeks and months can add layers of understanding that more adequately capture the complexities of such an event. Bowman argues that initial coverage has informed sociological critiques that characterise all attempts of journalists to report the "facts" as superficial and misleading (Bowman 2003, P.225). Specifically, in coining the term "the web of facticity", Tuchman argues that, in constructing accounts around the six elements of the five Ws and the H, journalists come to examine complex realities in a most superficial manner (Tuchman 1978).

Bowman (Bowman 2003) counters Tuchman's claim by arguing that journalists combine the practical need for "timely coverage" with their commitment to the pursuit of a "higher truth" through continuing to develop such stories for days, weeks, months or even years. He argues that those seeking to combine such an ethical commitment to truth-seeking inquiry combine the necessities of more immediate audience demands with a dedication to ongoing inquiry across a range of sequential levels. Bowman sets out the levels in the following way.

Level 1 – Reactive reporting: Reactive reporting for journalists is the basic source-orientated information used to report on a story. This information is found at the origin and, as Bowman states, is also controlled by the source of the information. This approach is considered reactive in journalistic reporting, as it originates in the reaction of the journalist to information generated elsewhere (the source). It is also a second account based upon information where the priorities of the source in presenting the information may differ from the sorts of material that the journalist ideally seeks.

Level 2 – Analytic inquiry: Committing to inquiry with depth, the journalist enters into analytical reporting, considering how an event develops over a period of time or the post-reactive phase. The focus here turns to the how and why in the web of facticity. Analytic reporting applies not just to the primary persona of the occurrence or event, but also to the contextual information, which resides with institutions, authorities and their officers, and which unlocks answers to deeper questions and helps (in journalism) to reveal who is to "blame" and who is to be "praised" before, during or after an event.

Level 3 – Reflective inquiry: This level of inquiry for the journalist focuses on the deeper social trends and approaches that were the precursor to events. This reflective view considers broad patterns and so can also signify future events in recognition of repetitive cycles.

To give an example of how these levels apply in research context the need for artist/academics to combine the production of a dramatic work with the academic representation of that drama has some parallels with the work of Bowman, who deals with the need for journalists to produce a definable, timely product that stays true to the overriding professional goal of "truth seeking". Bowman's approach that, he argues, combines the practical need to provide a timely news product with a deeper need to more fully develop, over time, explanations of important issues, has some things in common with more "artistic" endeavours in the Creative Industries Faculty.

Where journalists might describe their goals as a search for a qualified "truth", artists are more likely to represent their work as a search for meaning, in all of its forms. In both cases, to establish an ethical (journalism) or academic (artists engaging in the academic field) credibility, practitioners need to exhibit a method that can lay claim to a meaning beyond that which appears on the surface of the artefacts produced.

The typology that emerges from the three levels of inquiry as found in journalism (Bowman and McIlwaine 2001, p.229-230) translates well to the world of practice-led research and especially to research that generates NTRO. The following tables present how these levels apply to practice-led research.

Table 1: Level 1 - Reactive inquiry

Journalistic **Levels of Inquiry**	**Practice-led/based** **Levels of inquiry**
• Basic reporting • Information is found at the origin & controlled by the source • Direct reporting of action & information generated elsewhere • Who did what where and when?	• Basic recording/documentation • At the origin and controlled by the originator • Direct documentative action • Who did what where and when?

Table 2: Level 2 - Analytic inquiry

Journalistic **Levels of Inquiry**	**Practice-led/based** **Levels of inquiry**
• Post-reactive: Considers contributions over a period of time • Focus on the how and why? • Look at context: institutions, authorities and their officers • Who is to blame or praised before, during or after the event in the journalistic context	• Post-reactive: Considers the effects of time/development, continued experimentation or repeated cycles • Focus on the contextual: fully documented histories (how and why?) • Look at contextual influences and even particular characters that played a role • Consider impact and analyse practice, delivering comment on influence (who), practice (during) and post-research impact (after) the academic context

Table 3: Level 3 - Reflective inquiry

Journalistic **Levels of Inquiry**	**Practice-led/based** **Levels of inquiry**
• Deeper social trends • Precursor to events • Broad patterns and events	• Interrelationships/collaborations/community/site and field • Consider trends that brought change • Work and impact to global perceptions & relevance in a range of contexts

Consequently, for a Hybrid Publication to represent a "proactive" multi-dimensional representation of the "who, what, when, where, why and how" (the five Ws and the H), a model needs to be devised. My model adopts this process of staged inquiry as one of the principles for conducting research and publication within the Creative Industries. It also facilitates the simultaneous gathering and examination of data from the practices and products of non-traditional researchers, elevating this material through a process that, in appropriate instances, can elevate the search for academic merit *above* an approach that concentrates, solely, on artistic merit. In seeking to do so, my model provides the means through which researchers might foreground a dynamic multi-dimensional equivalent of a research journal or lab book; a three-dimensional mapping of a proactive and transparent inquiry process; and a "web of facticity" at one and the same time, chronicling and connecting the six elements of narrative construction.

Such a multi-faceted model that uses rich media to articulate creative and documentative action of the performative practice-led research with mainly NTRO must act both as a historic logger and an evidential organiser. In this case, to fully capture the research process to allow further development, critique and reappraisal, the evidentiary logger needs the capacity to trace the antecedents of a particular piece of research; the relationships between previous research outcomes that produced a refinement or recanting; and, for the future, to project forward to various works in progress that examine similar objects in the same, or different, ways, and that relate new understandings to each other in the same, or different, ways.

This is the baseline for the *augmented* dimensions of facticity, where I argue that the base questions of the web of facticity—the "who, what, when, where, why and how?" from journalism—provide viable concepts to address critical inquiry in the new paradigms formulated as performative research (Haseman 2006), artistic research (Coessens, Crispin and Douglas 2009) and practice as research (Nelson 2013).

4.1.2 Attributed Evidential Elements

Attributed evidential elements form the basis of establishing fully documented evidential trails. The basic reactive reporting of the five Ws and the H provide the basic data required to establish such evidential trails, which will ultimately lead to the next step, which is to establish and recognise provenance in scholarly work with NTRO.

4.1.2.1 Mapping the When and Where

Using the interpretive table below, I explain the key concepts of the web of facticity in one quick glance that provides further context to my projects.

Table 4: Contextual explanation of the web of facticity

Web of Facticity	Contextual explanation
Who?	The researcher identified through research master and the institutional records existing
What?	The event or activity that occurs e.g. Performance, exhibition, field trip, interview, meeting etc.
When?	The date of event occurrence
Where?	The place of occurrence
Why?	Information relating to the project such as the problem, the methodology
How?	The methodology and research design being followed by the researcher

However, the *when* and *where* are two sets of data that stand out differently from the others. In the initial description of the Hybrid Publication concept, these were evident too. In the model the *time data* featuring as date (the date of the event occurrence) inclusive of the timeline (the start, end and duration of the project) and the *geo-spatial locality* of the event (GPS coordinates) can be pinpointed and mapped. Both these sets of data are equally important and they are absolute universal datasets that can be captured but cannot be manipulated. Such temporal and spatial data can determine origin, attribution, duration, source and background. As such they play a significant role in NTRO evidential elements and trails.

4.1.2.2 The Existence of Attributed Evidential Elements

The principles of Hybrid Publication also call, secondly, for *attributed evidential trails.* These are found in the documentative and creative outputs and trails. Typically, in today's performative research, these events are captured in the form of audio, image, video and text, the big four rich media elements.

Primarily the media elements enhance the recording of practice for the researcher with mainly NTRO. As each event during the research journey has significance, so too does each element used to record it for analysis or evidential reasons. However, for adequate attribution such elements are necessarily impregnated through a fifth and overarching element that is the metadata, the element that is essential to the provision of meaning, richness and discoverability to our research outputs. For the purposes of the CIF NTRO model, the metadata would need to provide a futuristic timeline that would allow for someone a few decades from now, who is not familiar with the particular research project and its research outcomes and results, to examine it. Metadata has a role in the storage, management, discovery and sharing of data (or artefacts). Metadata provides the essence in the statement "create once, use many times".

Rich media carrying meta-rich information can answer the questions posed by the three levels of inquiry, in that research components such as an exhibition, drama, code— the embodiment of the artistic delivery, the creative and factual writings—in

all cases can attribute key sources that tell us "who" is associated with the event, "what" the event is, "when" the event occurred or will occur, and "where" it will occur.

These elementary questions provide the foundational answers to inquiry that will generate useful data (and metadata) for modelling when looking at research projects that present NTRO. To explore how others might have done this in more traditional research arenas; I looked at works that visualised events, depicting commonalities of event, time and place. Such examples are found in epidemiology and, more directly, the visualisation of the origin of disease and its spread. An example of this is "Exploratory visualization of temporal events in epidemiological research: Case study of the Black Death" (Madzudzo 2007). Examples also occur in areas such as Enhanced Geothermal Systems mapping (SketchUp 2008), or in the mapping of earthquake epicentres (Braile and Braile 2001). I expand on the significance of this information during the "Modelling Prelude" in Part 5: below, 36.

Commonalities in the above-mentioned types of visualisations incorporated multivariate[5] spatiotemporal[6] data. Geo-spatial data or "where it happened" also now has the same prominence as the "when?" of the event for establishing a timeline. The "where?" is in many cases descriptive in normal discourse such as "…the arts centre" or "…at the university theatre". However, for the purposes of a rigorous model researchers should locate events in time and space through the temporal and geo-spatial data. Preferably the researcher can provide an absolute, such as a position in a sequential date timeline, or the position of a specific place on earth. The geo-spatial capture of Global Positioning System (GPS) coordinates can provide us with absolute evidence of place within the model that can then be used as attribution and to assist with further inquiry and analysis. Together a three-pointed positioning of

[5] A number of random but often related statistical events
[6] Information relating to space and time

time (1 point) and location (2 points) can provide a type of "provenience"[7]. This concept is further explained in *Section 4.1.3 Provenance*.

In summation, the time (when) and the geo-spatial location (where) of event occurrence are absolute markers reflecting the concepts alluded to in the original Hybrid Publication Model. These markers are used as accepted methods of mapping evidential trails, or data, as previously demonstrated by other scholars such as Madzudzo and the Brailes' method. Individually and collectively, such attributions of research outputs answer questions from the web of facticity. This knowledge is required for establishing the three levels of inquiry. It provides data of background, source, duration and origin.

The Hybrid Publication Model starts with the timeline that forms the spine of the research journey. This is a linear sequential representation. It can be followed from the start of the research project to the end and at representational positions we can mark the precise time (the date stamp) of when something (an event) occurred. Subsequently the occurrence of an event provides another set of data to provide the answer to where an event occurred. In this digital age metadata and available technologies (such as a smart device) allow us to capture the precise location of an event (GPS coordinates). The result is a three-dimensional nonlinear representation of a single position in space. The collecting of the three coordinates from the temporal and spatial data allows the practice-led researcher to inquire at the first level (reactive) and document this inquiry. By mapping such data, the delivery of the NTRO trail starts to become a more sophisticated representation for post-reactive and reflective inquiry. Such inquiry can be in both the linear-sequential and the more exploratory sub-directions of the nonlinear, depending on what is used as the main starting point of inquiry. This means that, for example, the researcher might be more interested in what happened at a certain place, and when they start using that as the catalyst then each geo-spatial position can have its own timelines associated with it (a type of forensic chronicle).

[7] Provenience is an archaeological term that describes a find in the context of location, lot and bulk of find

I conclude from the above paragraph that the starting point in the delivery of a more sophisticated and thorough method to demonstrate creative practice-led research begins with mapping the temporal and geo-spatial dimensions in relation to the establishment of provenance for research. To achieve this outcome, researchers can use the Hybrid Publication Model that is populated with mainly NTRO.

4.1.3 Provenance

The term provenance can take on different meanings, when applied to different fields. To formulate the practical meaning of provenance for practice-led research in the Creative Industries I needed to adapt approaches that are applied to the particular needs of the CI NTRO field.

4.1.3.1 What is Provenance?

A crude Google search will quickly bring several meanings of the word provenance. In the sciences it points to the replicable evidential trail, in computers and the law (forensic) it points at ownership and usage, for archaeology we find the term "proveniance" meaning a three-point coordinate of find, and in the fine arts provenance is defined as a fully documented history of the creation process (Moreau et al. 2008).

In terms of the CI Hybrid Publication, a particular adaptation or synthesis of the meanings of provenance is needed to ensure the most applicable approach, and to ensure that the complete representation of a project involving NTRO research data is contained within the Hybrid Publication.

For this project, then, provenance is conceptualised and mapped as what the scientific world calls the audit trail, lineage or pedigree (Hey, Tansley and Tolle 2009). The purpose in using such an approach to provenance in developing my model is to allow for the establishment of academic rigour in the representation of performative research, an approach that facilitates the replication of social scientific

inquiry principles. Establishing such rigour requires that explication and understanding of performative work must move beyond that which can be appreciated, for some, simply on the surface manifestation of a work that has much deeper dimensions and that can make a profound difference to human understanding.

As discussed earlier, I have adapted a staged inquiry approach from the field of journalism to pursue these deeper dimensions that, on articulation, can exhibit greater academic rigour. Furthermore, the model is designed to adapt the search for deeper understanding to the practical requirements of the field. In many instances, such competing requirements might appear at odds and such tensions are only, ultimately, resolved through systematic approaches to the ongoing development of the work. Journalists describe such approaches as a pursuit of "truth" while non-traditional artists might characterise this more cerebral dimension of their work as a search for "meaning". The work of journalists and artists converge, however, around the need to adapt inquiry approaches to the practical realities of their respective fields. In the case of journalism, an overarching commitment to truth telling and the search for the "facts" must in individual instances be adapted to the other requirements of the field: the need to produce a timely account of a major event according to commercially driven news deadlines. Correspondingly, in the arts, this adaptation must take into account two interrelated needs: the need to perform a piece of art that can be appreciated by an audience as art, and the need to distil from this performance principles applicable to the building of knowledge about the performative field within the wider academic field and according to the rules that apply to the demonstration of new knowledge within the academic field.

4.1.3.2 Defining Provenance for Creative Practice-led Research in the Creative Industries

In the case of art or the arts, the provenance, of practice-led research becomes the capturing of origin, attribution, source and background to all artefacts and events that form part of the output of the research. Through the process of establishing or confirming provenance, the research must articulate and follow a method through which the authenticity (via the evidential trail) of the outcome can be established.

This means I can now define provenance for creative practice-led researchers in the Creative Industries as: “The capturing of origin, attribution, source and background to all artefacts and events that form part of the output of the research”. Such an approach provides the mechanism to critically inquire about the research at all levels of the study. Over time, this approach can capture the immediate, the intermediate and the long term of the reporting, as reactionary and considered in analysis and reflection.

In this sense, the Creative Industries shares with the fields of art history and archaeology the need to map such needs onto the provision of relevant data that still maintains some core benchmarks, such as:

- Background (contextuality),
- Information on ownership, and
- Attributed evidential proof of practice, discovery or impact.

Artists working within the Creative Industries need to identify such attributes where they wish to claim their work as research and their outcomes as research outcomes. The difficulty for the artist/researcher in the non-traditional area is that they must perform a dual role. Their aim (professional practice) is to create a piece of art, or exhibit an artistry, that appeals to a general audience that does not specifically cater to academic requirements at all times. People coming to see a play are seeking to engage with art as entertainment and art as inspiration; these are particular factors which an academic treatise on the same subject matter might not prioritise. So a difficulty is created. How does one direct a successful play while, at the same time, producing a piece of research? How can this, firstly, be described and, secondly, modelled? I argue that the research component of artistic academic endeavour—where artists seek to articulate a work of art in the research domain—often moves through a range of levels where the three points set out above are progressively developed to greater depth and complexity.

4.2 TEMPORAL AND SPATIAL MARKERS

Many times during this research series the questions relating to the five Ws and H are asked: "who, what, when, where, why and how?" The first two (who and what?) can easily be answered by the existing research master records and research statement. The next two are the when and where? These markers are important to claim provenance. The original concept of the Hybrid Publication also centred on these markers, as illustrated in the table below.

Table 5: Reference to temporal and spatial markers

Statement	Meaning
"…Every research project has a start and finish point…"	Indicating the capturing of a start and finish date from which a duration or period of time can be derived and expressed or recorded as evidence to form a spine for a timeline.
"…Along this timeline we find action, events and happenings…"	Indicating a singular point of time (date) when an event actually happened, which can act as a definite point marker and visual representation along the timeline.
"…Along this timeline we find action, events and happenings…"	Events occur at a captured place, which, when captured, can be displayed as a definite point of origin.

As mentioned in Section 4.1.2.1 above, time and spatial information are two definite demarcations that cannot be artificially manipulated. In creative practice-led research with mainly NTRO, this statement in the pursuit of building fully documented evidential trails becomes extremely important. The following two sections expand on the temporal and spatial elements associated with such research outputs to provide a clearer understanding of the pedagogical importance associated with these demarcations to support my summative statement that follows:

A researcher needs to complete temporal and geo-spatial logging of events and tagging of all rich media elements that can be attributed to the research project in order to create metadata from which an evidential trail and web of facticity can be demonstrated.

4.2.1 Temporal – Timelines

Timelines are for anyone with a story to tell. A timeline is usually a chronological representation of events that occur over a period of time. Examples of timelines are easily found in the retelling of history, the marking of significant moments in time, or, in a more specific example, the judicial application of evidence reconstruction to provide a cohesive story to bring before the court.

In the field of research, practitioners construct timelines in the planning phase, and when the project begins they use them to monitor the research, log the events or discoveries that emerge during the research process and, finally, chronicle the research summation and detail the outcomes.

In the process of research, then, each step along the timeline is important in its own right. However, at this level of the research in DCI Project 2 the timeline assumes greater importance than that revealed in DCI Project 1. Because, the relationships between the events, in this more sophisticated model, can span increasingly deeper, or broader, levels to provide an interpretative picture. For the "insiders" it is a decoder and transmitter of their work. For the "outsiders", who were not directly involved in the work, it can help with more speedy cognitive understanding of more sophisticated propositions. In this model, which seeks to tell us all that represents NTRO research, visualisation of a timeline introduces interpretative dimensions that allow for a greater ease of recognition of patterns or cycles. Such multimedia timelines move beyond the text-based recordings that often were the limit of earlier attempts to record non-traditional research. These text-based diaries or journals of researchers would provide a date of the entry or event, a description of ideas and thoughts around the project, notes, impressions, interpretation, comments about the research process, reporting accomplishments, and reflections on everything related to

the research. In such a construction, it is the date sequence of the entries that, automatically, forms a timeline.

The particular nature of non-traditional academic research in the Creative Industries has lent itself to the development of multimedia timelines that can be supported through the incorporation of rich media elements. These elements provide a more nuanced description of the research and allow for informed "outsiders" to follow the timeline, interrogate event instances at will, even out of sequence, to a degree manipulating the construction sequence to access more sophisticated information. This could be interpreted as following a particular forensic timeline. Again, we enter the interpretations of terms such as forensic to indicate "discoverable and evidential". Consequently the two types of timelines that are simultaneously present in the Hybrid Publication are the linear sequential and the forensic evidential. Both answer the question "when?" and both offer further discoveries of the "who, what, where and how". The timeline as described in the conceptual development in DCI Project 1 remains the spine of the model and one of the anchor points of events. However, to situate such timelines through a mechanism that can prove the three levels of inquiry, it is necessary to locate various phenomena in time and space: to create a geo-spatial mapping of these particular movements in research and artefact location and development. To situate this further conceptual development in the DCI Project 2 model approach, it is necessary to discuss the background, and meaning, of spatial information.

4.2.2 Spatial - Geo-spatial

The Cooperative Research Centre for Spatial Information (CRCSI) is an international research and development centre set up in 2003 under the national CRC Program as a government initiative. They describe spatial information as: "…the physical location of objects and the metric relationships between objects—information fundamental to the lives of every Australian…" (Murphy et al. 2015). Spatial information has meaning for the sciences, health, logistics planning and design services. It is a relatively new information technology field and the SI industry is a component of the broader IT sector. Applications of the spatial information data have found their way

into diverse and widespread areas such as the fishing industry, aviation, transport and telecommunications.

In the Creative Industries, spatial information takes on its own specific meaning. Every single event in the Creative Industries holds spatial information. I am not talking about the performative space but the specific space of locality in event occurrence. Digital files of many types hold spatial information, which can be found in the properties of the artefact captured as the metadata, recorded at the same time as the creation of such an object.

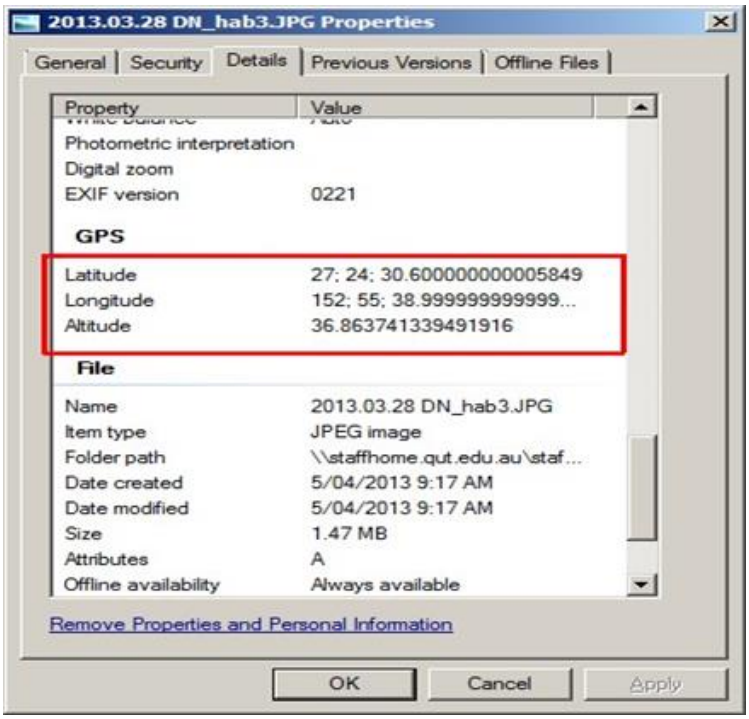

Figure 15: An example of spatial metadata stored as properties of an image

Every time we take a photo, record a video or audio, write a text, perform a play, dance, or design a structure—even program the movement of an intelligent light—we are addressing and recording spatial information. If we are recording it, we must be able to recall it too. So, spatial information in our practice becomes a definite marker and evidential trail to substantiate the originality of any occurrence or artefact. In relation to the Creative Industries, these basic pieces of data are obvious and freely available, if we know where to look. For example, the poster (advertisement) of an event will explain who is going to do what, when and where.

Such granular spatial data often provides answers to the questions of the augmented web of facticity at a glance:

- Identification & Collaborations – (who?)
- Action – (What? How? Why?)
- Temporal Data – (When?)
- Spatial data – (Where?)

The metadata now becomes a key operative in locking elements in virtual space with time and location. The ability to represent such data accurately provides us with the skeletal form of this "forensic inquiry" of the presentation. If such a skeletal form is available the visual layers of representation (elements/objects representing events) become the epidermal cosmetic layer of identification. We can recognise in an instant the whole of the research project and its various components.

So far, in order to establish my model I have outlined the theory through which the interrelated research into the nature and significance of various artefacts in terms of three levels of inquiry becomes apparent. I have highlighted the significance of the temporal and spatial elements as providing pathways to provenance. These pathways remain theoretical until further work is done to properly model the resources that allow researchers to access (link to attributes with-) proof of ownership and attributed evidential proof of research practice, discovery and impact. In Part 5: below, I explain the pragmatic and cyclic experiments that led me to the final proof of concept model in this series.

Part 5: MODELLING PRELUDE

In section 3.2 above (The Conceptual Hybrid Publication Model), I present the origins of the model that I develop in this research series. The multi-perspectival tool that produces the proof of concept of the Hybrid Publication Model is constructed through a combination of the Hybrid Publication principles in section 4.1 and the attributed modelling that is used to chart the evidential trails and ultimately to demonstrate provenance. In the following sections, I provide an overview of this pre-production phase, establishing the fundamentals of subsequent experiments that are a precursor to the experiments in Part 6, 47.

5.1 SIMPLE QUESTIONS

Making the Hybrid Publication Model real required me, in the first instance, to frame questions again:

- What is it that I want to show (visualise)?
- How will I gather the data required?
- If I can do it, with the tools I use and create, will others be able to use these same tools to capture and represent their own work?

To inform my questioning, I examined other fields where comparable work had been performed.

5.2 CONTEXTUAL INFORMANTS

My investigations concentrated on types of visualisation, location plotting and temporal representation. In short, what happened, where it happened and when it happened. Elements of such data representation I found in works such as: "Exploratory visualization of temporal events in epidemiological research: Case study of the Black Death" (Madzudzo 2007), Enhanced Geothermal Systems mapping (SketchUp 2008) and in the mapping of earthquake epicentres (Braile and Braile 2001).

The Madzudzo study focuses on the representation of spatio-temporal data based on the Peuquet Triad Framework of 1994 (SILvA), which states that the user of spatio-temporal data is greatly interested in addressing three key questions: “what”, “when” and “where”. All three of these elements are important in the analysis of NTRO data, where I am promoting the need to continually visualise, capture and construct fully documented histories or evidential trails. In this regard, the Enhanced Geothermal Systems (EGS) mapping by Alex Oliver of Igloo Studios used spreadsheet data to visualise and plot specific GPS locations and represented them in cloud maps, combining this functionality in SketchUp. I used the same software (SketchUp) to build my model and adopted the use of scripting a construction point at the GPS location. In the works of Braile and Braile, I found similarities in the data sheets of event, time, location and descriptors presented for a map plot. Such work prompted me to investigate and, ultimately, to decide on how to set up the positive and negative orientation hemispheres that relate to earth and geo-spatial location.

5.3 WHAT DID I MAKE?

Two types of representational models of the Hybrid Publication were made in this project:

1. The 2D linear model – Temporal representational model with attributes, and
2. The 3D Model – Spatio-temporal representation with attributes.

The experimentation with the 2D and 3D models was conducted simultaneously. Because, the same questions and arguments were tested simultaneously so the interrelated uses of the models could be examined. The outcome is an instrument that enables researchers to track, visualise, reflect upon and critique activities that they have presented as a publication of their outcomes. To establish this publication model I first had to frame the foundational design principles. The main foundational grounding of the model design is located in the multi-dimensional levels of inquiry, based upon the journalistic approach to truth seeking. This approach is much the

same as starting with the superficial web of facticity and delving into levels of inquiry as formulated by Bowman and McIlwaine. This was described in Section 4.1.1 above (The Augmented Dimensions of Facticity).

By framing these design principles, I set goals for what my experimental models must portray, including:

- Temporal representation of a research project,
- Geo-spatial locality of research project events,
- Visual reference to the multiplicity of significant events including duration and type,
- A method to guide the inclusion of short-form and long-form annotation or notation functionality, and
- Attributes of rich media elements as documentative evidential trails or supplementary NTRO.

5.4 DCI PROJECT 2 - CYCLIC TRAJECTORY

After setting these goals, I planned the staged modelling process that would eventually take me to the results from the experimental series. The process included the following stages:

Stage 1: (*Machinima* Test Trial) Model the test trial project *Machinima* to best reflect the mind image of the Hybrid Publication Model.

Stage 2: (Theoretic Development) Reflect and use the lessons learned from the previous model, refer to the theoretics of the Hybrid Publication Model, and find coding solutions to best represent the desired outcomes by modelling a theoretical test model.

Stage 3: (Proof of Concept) Reflect and use the lessons learned from the previous model to further enhance the coding while modelling my own DCI project as the proof of concept model.

These staged cycles of progressive development, ending in the proof of concept, inform the narrative of the postscript.

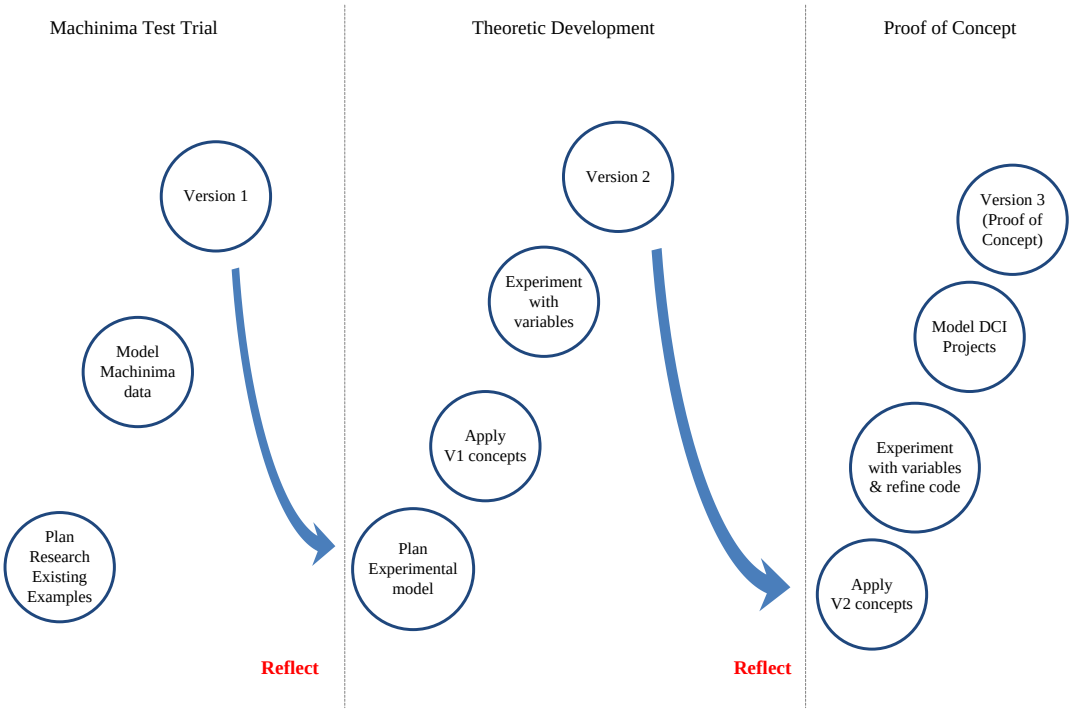

Figure 16: Research trajectory following the cyclic model

5.5 EXPERIMENTS

Several experiments were planned to effect the staged development mentioned above and executed in the making of the models.

Table 6: Experiments for Hybrid Publication Model

Test Case	Experiment	2D	3D	Comment
Test Case 1	Test Case 1		Yes	Orientate the data and visualisation – 1st temporal and spatial exploration
Test Case 2	SU 01 Exp		Yes	Event objects and attributes, data logger development, data flows for 2D and 3D
Test Case 2	H-Pub Test 1		Yes	POC Test - Multiple events at a single location
Test Case 2	H-Pub Test 2		Yes	POC Test - Multiple events at multiple locations
Test Case 2	H-Pub Test 3		Yes	POC Test - Events with rich media
Test Case 2	BD 01 Exp	Yes		Represent the 3D data of *Machinima* in 2D timeline
Test Case 2	BD 02 Exp	Yes		Demonstrate the ERA package as timeline and single artefact
Test Case 3	SU 02 Exp		Yes	Use the data logger and representations to demonstrate project and project events
Test Case 3	BD 03 Exp	Yes		Demonstrate a sequential timeline and forensic timeline

5.6 MAKING MODELS IN 3D & 2D

As mentioned above, to create the 3D Hybrid Publication Model I had to traverse through three stages of development. In **Stage 1: (*Machinima* Test Trial)** I focussed on developing the basic principle of how to represent time and event occurrence in the model (Test Case: *Machinima* Test Model - Hybrid Pub Model V1).

Stage 2: (Theoretic Development) is a theoretical 3D model[8]. It provided the opportunity to design, write and bed down the code that makes the model work as an automated visualisation. Significant work went into this development, and it constitutes the majority of the code development phase.

[8] A model derived from a set of constructed data to represent known elements and events that will appear in the models.

In **Stage 3: (Proof of Concept)** I modelled my own research project. This was the ideal opportunity to map a performative, creative practice-led research project in full. Essentially, this provides a proof of concept for the Hybrid Publication Model. At this stage, which is the final and full spectrum of this research project, the theoretical development and a working model to prove the theories about such a model are delivered.

These three stages of development reflect the work required to satisfy the questions asked in Section 5.1 above (Simple Questions). In turn the simple questions are practical steps to demonstrate the principles required[9] to establish a Hybrid Publication that stands with rigour. Each of the three stages of development takes the researcher on a journey where they can show the existence of the augmented dimensions of facticity. The three-stage process simultaneously provides a methodology for accessing evidential elements that articulate and model NTRO scholarly work, in a way that establishes provenance.

5.7 PREPARATIONS FOR MAKING THE MODELS

I took two preparatory actions before I started modelling. These were:

1. Visualising the mind image in a virtual environment to unlock questions, and
2. Engaging with advanced 3D drawing software packages and consulting with design software specialists to identify which design software to use.

5.7.1 Visualising the Mind Image

I first created a visual representation of my mind image using Unity, the gaming software development system, to create the spatial-orientation placement, look and feel. This free action drawing of objects in space was valuable in forming my understanding of the future model in 3D space.

[9] These principles include the "augmented dimensions of facticity", the presence of fully documented evidential elements with attributions of time and space, and the establishment of "provenance".

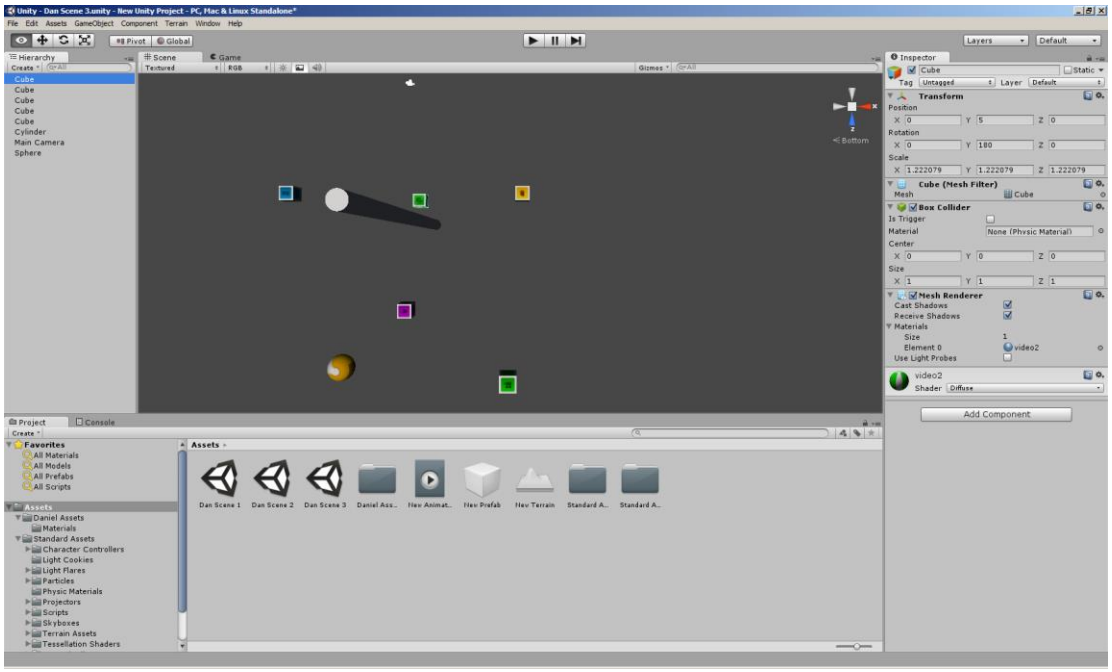

Figure 17: Unity display of a free drawing of the Hybrid Publication Model

5.7.2 3D Drawing Experiments

The next step was to investigate the possibilities of using 3D drawing software in the development. I chose to investigate Solid Works, the main 3D drawing design software used by the Creative Industries Technical Services support group for the School of Design at QUT.

Principally, I needed to use the 3D drawing environment to explore the spatial orientation relative to geo-location and to create and locate an object. It became evident that pure high-level design software, such as Solid Works, was not sufficient to the task of combining geo-location and temporal representation. Creating a defined "world" was essential for Solid Works. This defined universe would enable me to plot locations relative to a certain point within the model.

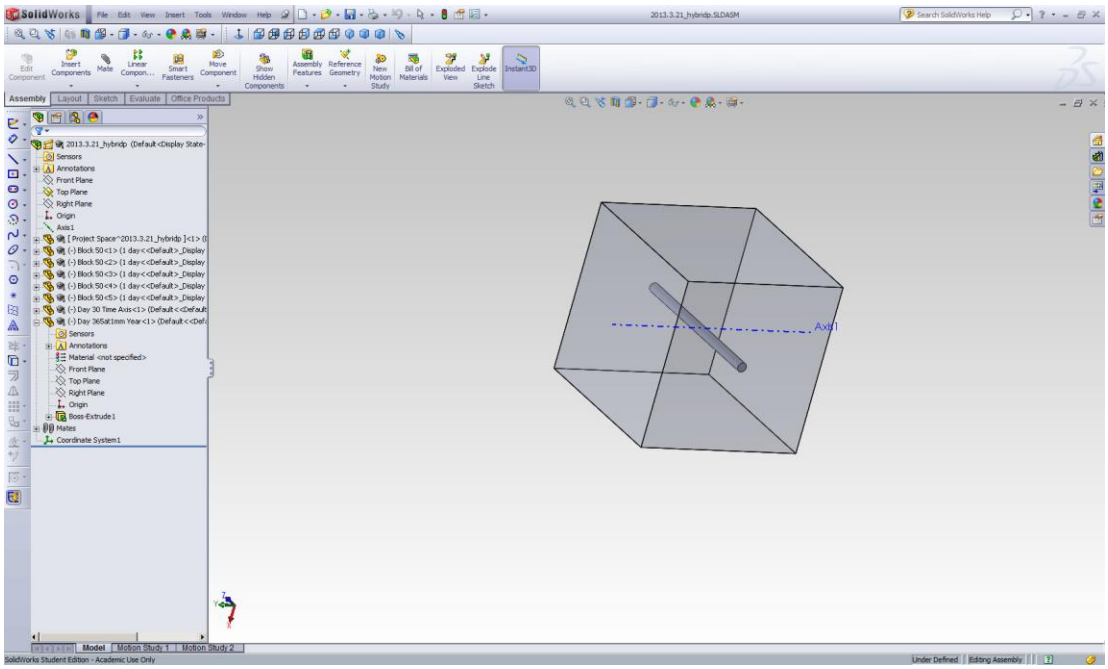

Figure 18: Solid Works requires a defined universe

Instead, I was searching for a situation where I could use an "existing world" to enable my geo-location objectives. Defining a "whole world" in Solid Works was not the most effective approach to such a problem, but in the process, basics such as the appropriate orientation of axes, and what they represented, emerged.

Figure 19: Axis orientation in design

Investigations led me to use my understandings of Solid Works to seek out an alternative solution that could provide wider functionality. I therefore mapped the axis orientation to geo-location and temporal events as follows:

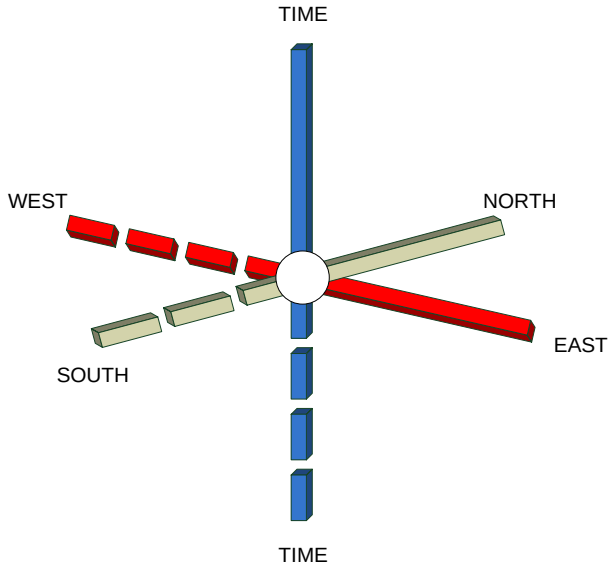

Figure 20: Axis orientation in design

It was clear that I had to find a way to represent the data, and design a progressive and cyclic model of progress to develop the Hybrid Publication Model. To start with, there needed to be a consistent format of representing temporal and spatial data (using a common numeric format). I had to address this consideration as a requirement of any potential application used for modelling in this project. By this I mean that before I could plot data of time and space in the same model, I had to standardise the data format for both types in order to interpret it for spatial orientation within the model.

5.7.3 Selecting the 3D Creator

I opted to use SketchUp by Trimble Navigation Ltd. SketchUp was developed through a number of phases. The first, independent stage was from 2000 to 2006 before its acquisition and development by Google from 2006 to 2012, and then from 2012 under Trimble, a mapping, surveying and navigation equipment company. As a 3D modelling and drawing package, SketchUp is easy to become familiar with in a short period of time. The owners and distributors of SketchUp, Trimble Navigation

Ltd., provide access to vast resource repositories online. These repositories provide resources to allow for coding, and also accommodate third-party program plugins to enhance or customise the software by, for example, providing accurate placement of models in Google Earth. Such enhancements and experimentation with the program are encouraged, and naturally provide many augmentations and specific functionalities that are not part of the base-level clean install at the beginning. This ability allowed me to demonstrate the geo-location functionality and its particular relationship to the Hybrid Publication Model. The experts in SketchUp provided information that is key to much that I claim as new work. Specialist application development was needed for me to adapt SketchUp to provide the sort of model necessary to my particular task.

I then decided to use SketchUp because it delivered the following contributions to my cause:

- Ease of use,
- Online repositories,
- Active developer groups, and
- Plugins – Use of API (Application Programming Interface).

5.7.4 Selecting the 2D Representation

In many respects, the 2D Hybrid Publication Model is a timeline representation. The main purpose of the timeline within my study is to chronicle the research journey and its data. In particular, the journey associated with this study is that of the practice-led researcher with mainly NTRO.

Timeline representation in research practice resides in a space of its own. It serves as

- A record of practice similar to a journal,
- A visual representation record that can be used as a presentation tool,
- A forensic evidence logger and, as a result, an archive of sorts.

The timeline is a research log that represents direct event occurrence (recording the first elements of the web of facticity). This timeline emerges from the present or past, because it tells the user when an event is happening or when an event has happened. By making this distinction, I give weight of authenticity to the timeline as a recorder of origin (a temporal marker).

5.7.5 Selecting a Timeline to Represent Hybrid Publication

Having access to the comparative data of timeline solutions by Fien Danniau (Danniau 2012) of the Institute of Public History at the University of Ghent in Belgium, meant that I already had a starting point for my search to identify a linear sequential log of research events, displayed in a sophisticated media object. I was seeking a timeline application suitable to the scholarly work done in the Creative Industries Faculty. The application needed to function in a way that dynamically represented documentative and evidential trails (using rich media elements) while maintaining the integrity of the temporal scale (timeline) and presenting data in a logical and succinct manner.

The Danniau comparison study data was generated in 2012. To prevent obsolescence I kept the top five timeline solutions and then searched online for the top five timeline solutions (applications) that had emerged since that time. The search came up with the following applications: Tiki Toki, BEEDOCS Timeline 3D, Timeglider, Dipity and Timeline JS, all of which were included in the comparative evaluations listed in the Danniau study. To apply the Danniau data to my study, I devised a further set of 11 criteria, and rated the above list of timeline solutions comparatively. The ultimate methodology was:

- The use of the Danniau comparison score,
- Followed by a five-point rating against the 11 criteria listed below.
    a. How easy is it to find the timeline simulation?
    b. Can I download it and install without problems?

c. Has the timeline been established and survived at least 12 months online?

d. Can the timeline representation import data from a *.csv file?

e. Can the same data be used in the 2D representation as well as the 3D representation?

f. Can I represent the work of a researcher in full, short and condensed form?

g. Can I add media to the events on the timeline?

h. Can the timeline accommodate all the file types previously associated with ERA?

i. Can the timeline be used online?

j. Can the timeline be used offline?

k. What is the "look and feel"? (a subjective score)

The data analysis table is shown in Appendix A: Timeline Suitability Score.

From this method my final decision was to use BEEDOCS Timeline 3D (www.beedocs.com) for my study of linear timeline representation.

5.7.6 Modelling Software Selected

I then chose the two software platforms that I would use to create, demonstrate and present the Hybrid Publication Model.

Table 7: Type of model and chosen software package

Type of Model	Selected software package to create the model
3D model	SketchUp by Trimble
2D model	BEEDOCS

I then started an initial experimental phase to identify the developments needed to further progress the conceptual model. I set out to construct the tentative model: *Machinima*, an ERA 2012 featured project of CIF.

Part 6: EXPERIMENTS

I used *Machinima*[10] by Lubi Thomas (Thomas 2010) to produce the first Hybrid Publication test model, which set out to create a 3D representation of the NTRO project.

6.1 CREATING THE MODEL THROUGH VARIOUS STAGES – TEST CASE 1

Table 8: Test Case 1: Machinima – Hybrid Publication Model V1

Test Case	Experiment	2D	3D	Comment
Test Case 1	Test Case 1		Yes	Orientating the data and visualisation

I created version 1 of the Hybrid Publication Model based upon:

- My visual 'mind image' – what I thought the Hybrid publication Model looked like,
- The theoretical arguments formulating the existence of the model, and
- The data provided.

My objectives in creating this test model were:

- Can I make a 3D model that represents this data?
- What can I learn from this model that will inform subsequent developments?

[10] Machinima is a research project that was submitted in the 2012 ERA round for CIF. The research field was curatorship of the Machinima genre – a film-making practice that uses real time 3D computer graphics engines to create cinematic productions.

Lubi Thomas provided me with original project documentation, including a project plan structured much like a Gantt chart. This information allowed me to determine the following points:

- Events are sequential in date order,
- There are 26 equal-duration timeframes,
- There is more than one event that happens per timeframe, and
- The project has a centre point or "point of origin".

6.1.1 *Machinima* Modelling Data

Data for this model was presented in an Excel spreadsheet that looked and felt the same as a Gantt chart and contained a schedule that represented time slots and events as goals. The red arrows overlaid on the spreadsheet below indicate the core information to be used and analysed in my experiment.

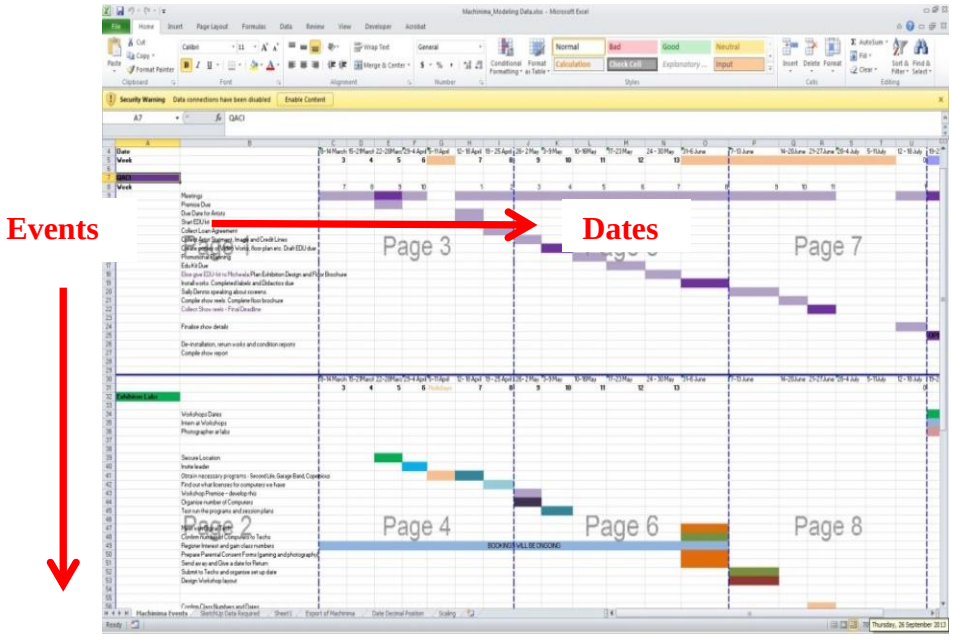

Figure 21: Screenshot of Machinima *project plan*

My first task was to separate this data into a vertical temporal representation. I achieved this by listing dates sequentially from top to bottom and horizontally populating the sheet with event occurrences. Essentially this action caused a change in visual perception from a Gantt-like chart to a list.

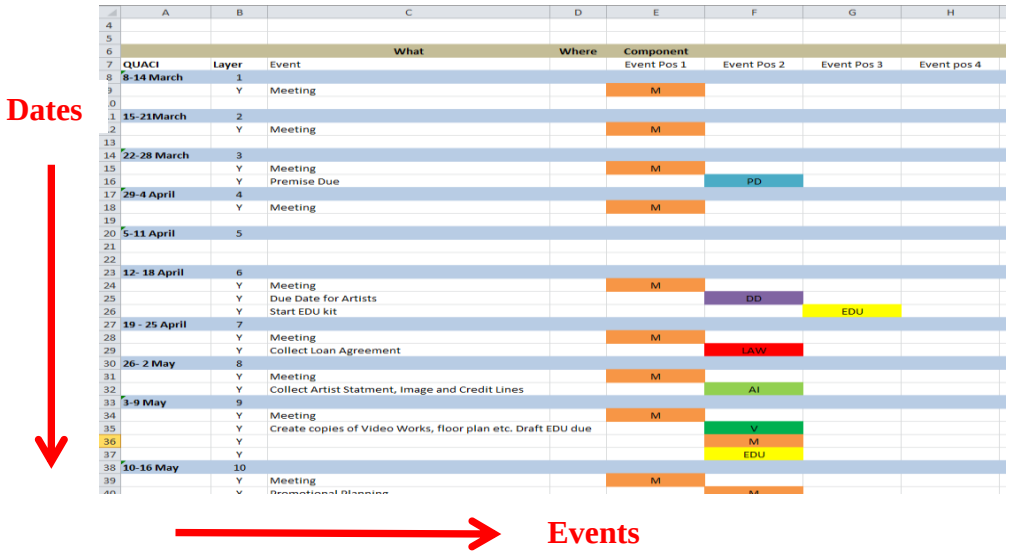

Figure 22: Screenshot of orientation change of Machinima *data*

This list appearance is what gave me the idea for representing these timeframes in a 3D model. To make the model, I orientated the drawing space as follows:

- x- & y-axis = Event position (spatial), and
- z-axis = Temporal.

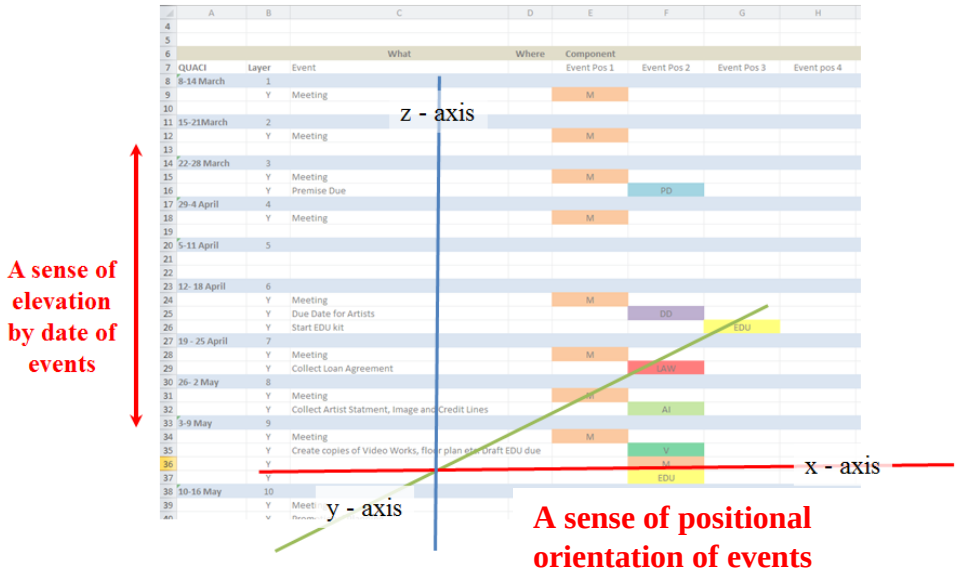

Figure 23: Data model orientations

The objective of rearranging the data into such a list is to pre-empt future model developments of representing event data in a 3D space, with one set of data representing the vertical positioning and another the horizontal positioning. This

would enable time and geo-location, two key datasets in the Hybrid Publication, to become the main orientation points in the first level of research reporting, addressing the items "when" and "where". To start with, the x- and y- axis is placed in the standard 2D orientation (plan view) and the z-axis in the vertical plane. The z-axis is the axis against which the date of occurrence would be plotted. The x- and y-axis is used to plot the positioning coordinate. By orientating the space in this configuration I could then input data against the three axes, which would essentially provide a single point in space (a provenience). This point serves as a temporal and spatial marker of origin. In SketchUp this action of plotting the three numeric values of the three axes' orientation to a single position is known as creating a construction point. In my models, the construction point is determined relative to the three axes' values generated from the recorded data, values that represent time and place or when and where.

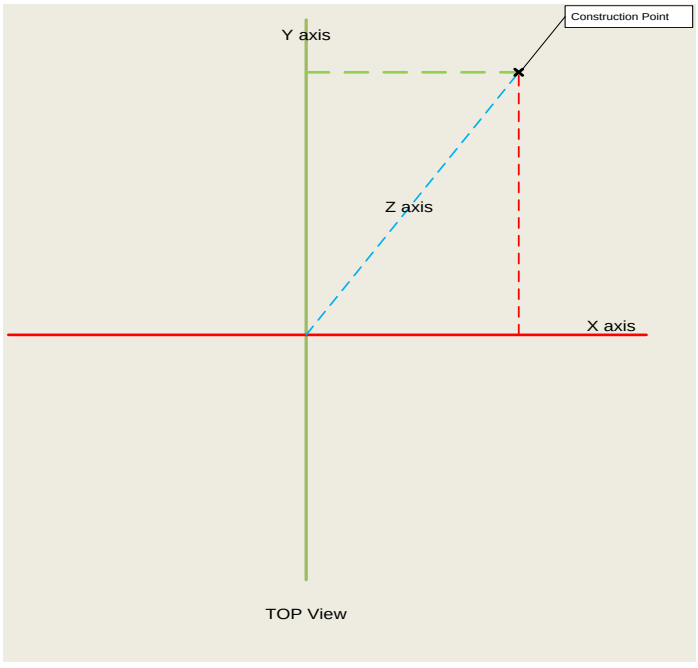

Figure 24: Locating the construction point

A series of construction points in 3D space can assist to define absolute positions. In the drawing of the cube below, each point that is defined as a construction point has a singular purpose. However, it also has a contextual relationship with similar points in the same model and space. As stated above, each point represents a value and meaning of its own; together, the points can be interpreted in several ways. One

interpretation is that together they form a shape, and in the example below it is recognised as a cube.

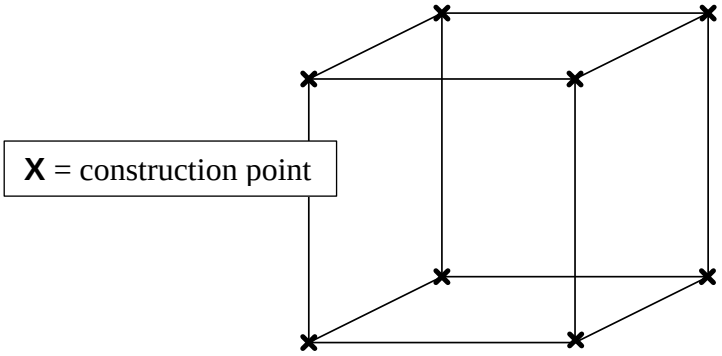

Figure 25: Construction point relevance

6.1.2 Time and Temporal Axis Orientations

The concept of time (z-axis value) plays a significant role in the Hybrid Publication Model; in my foundational framework I therefore ask the question, "When did it happen?" As theoretically formulated in the Hybrid Publication Model, my argument started with the statement that "…each project has a start and finish point". This means a period of time where the variance between the start and finish points indicates a duration that encompasses the events that occur during this time. It also means that, similar to a project timeline, the start and end points of the individual event time can be plotted to indicate its duration. The temporal position of the event, relative to a project timeline, is then visible. Consequently, addressing the design of the model in relation to the z-axis activity becomes the first priority of the test case. Below I show how I wrote an equation to explain the orientation and flexible positioning of a project timeline for the model:

$$z = \infty : 0 : \infty$$

Equation 1: Hybrid Publication time equation statement

In this equation, time is represented on the z-axis (vertical) and stretches from infinity in the past to point zero (now or, for example, the start of the project, a data-defined point in time) and from point zero to infinity. For me the equation provided

the opportunity to state that: point zero is a definable numeric value that is located using the numeric value of a certain date. This point was also defined later as the start of the active year. For example, if the year was 2013, then 1 January 2013 would start at 0 (zero) and continue on a positive rise to the end demarcation of 31 December 2013.

The practical question that arose from this equation was: "how would I represent dates (DD/MM/YYYY) on the z-axis of the model as an elevated position?" To do this, I had to find a scale of measurement (the numeric format) that could be associated with time or date, and find a specific point of elevation along the z-axis for both the start and finish of the project. On the completion of this task, I would be able to position and visualise the start and finish points of the project and use this visualisation as the "Timescale" of the project model. The timescale or variance (duration) between the start and finish dates becomes the visual entity that represents the duration of the project at a glance. This visual scale is an instant point of reference when considering an event that occurred before, during or after the project. Such a conclusion would, in analysis, speak to the three levels of inquiry.

To make the Timescale, I started with the reasoning that one standard year equals 365 days. Every fourth year is a leap year and consists of 366 days. If each day in the project over a period of a year is represented by a vertical height of 10m or 10,000mm or "Rise Factor", then 365 x 10,000mm will represent the Rise Factor of one standard year. This value is 3,650,000mm or 3650m. I chose to draw a cylinder of this length in the model to indicate the 12 months of the project, also termed the "Active Year". This cylinder now stood as the "Timescale" of the project, with its base at point zero. The term "Active Year" relates back to the time definition statement mentioned earlier, where the point zero can be defined by a numeric value and becomes the base of the "Active Year". The following graphical representation shows this timescale for *Machinima* rising as a white cylinder from 0 - 3,650,000mm.

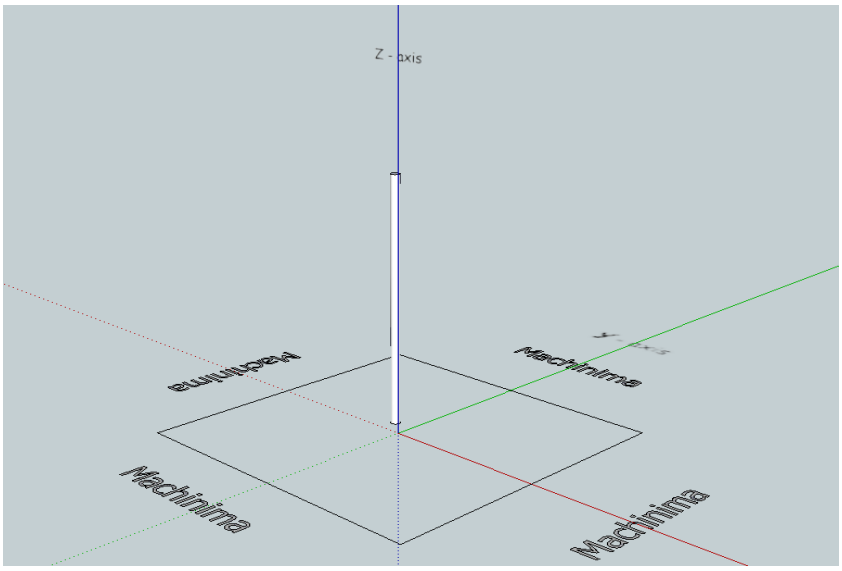

Figure 26: Machinima *timescale indicator*

In Microsoft Excel[11], the date 1 January 1900 equals 1.00, 2 January 1900 equals 2.00, 3 January 1900 is 3.00 and so forth. Using Excel in this manner, I created a set of numeric tables for the period 1 January 1900 – 31 December 2030, assigning the appropriate numeric value in relation to the date. This enabled me to instantly find and use the day number (the numeric value) associated with each of the days in this time period. The numeric value of each day increases progressively at the rate of a single digit per day. Excel is also advanced enough to add the additional day (29 February) of a leap year appropriately. These tables can be found as Appendix B. The following are short examples from the tables:

Table 9: Sample of Date Numeric Table of 1900, 1901, 1902 and 1903

1900		1901		1902		1903	
Date	**Number**	**Date**	**Number**	**Date**	**Number**	**Date**	**Number**
1/01/1900	1.00	1/01/1901	367.00	1/01/1902	732.00	1/01/1903	1097.00
2/01/1900	2.00	2/01/1901	368.00	2/01/1902	733.00	2/01/1903	1098.00
3/01/1900	3.00	3/01/1901	369.00	3/01/1902	734.00	3/01/1903	1099.00
4/01/1900	4.00	4/01/1901	370.00	4/01/1902	735.00	4/01/1903	1100.00
5/01/1900	5.00	5/01/1901	371.00	5/01/1902	736.00	5/01/1903	1101.00
29/02/1900	60.00	1/03/1901	426.00	1/03/1902	791.00	1/03/1903	1156.00

[11] MS Excel is a spreadsheet program that is used to store, organise and manipulate data. Excel uses formulas to make both simple and complex mathematical calculations.

Table 10: Sample of Date Numeric Table of 2010, 2011, 2012 and 2013

2010		2011		2012		2013	
Date	**Number**	**Date**	**Number**	**Date**	**Number**	**Date**	**Number**
1/01/2010	40179.00	1/01/2011	40544.00	1/01/2012	40909.00	1/01/2013	41275.00
2/01/2010	40180.00	2/01/2011	40545.00	2/01/2012	40910.00	2/01/2013	41276.00
3/01/2010	40181.00	3/01/2011	40546.00	3/01/2012	40911.00	3/01/2013	41277.00
4/01/2010	40182.00	4/01/2011	40547.00	4/01/2012	40912.00	4/01/2013	41278.00
5/01/2010	40183.00	5/01/2011	40548.00	5/01/2012	40913.00	5/01/2013	41279.00
1/03/2010	40238.00	1/03/2011	40603.00	29/02/2012	40968.00	1/03/2013	41334.00

In the case of *Machinima*, I applied the tables as follows:

1 January 2010 equals 40179 and 31 December 2009 was 40178. This means 40179 less 40178 equals 1 or "Day 1" of the Active Year. 31 December 2010 equals 40543, and 31 December 2009 equals 40178. This means 40543 less 40178 equals 365 or "Day 365" of the Active Year.

The visual representation of the duration of Day 1 in the Active Year starts at 0 and ends at 10,000mm; day 2 starts at 10,000mm and ends at 20,000mm. Such an approach places the last day of the year, 31 December, or day 365, at an elevation (Total Rise Factor for one calendar year) of 3,650,000mm (3650m). Thus, to calculate the accurate elevation point (start position) in a model, in a way that compensates for the real start position of 0, I must deduct the rise factor of 1 day from the numeric value of every day to determine the accurate elevation point (start point) of that day. For example: Day 1 equals 1 x 10,000mm equals 10,000mm less Rise Factor of 1 day equals 0mm. This means the stretch (duration) of day 1 will visually present from 0 to 10,000mm. Further, day 2 equals 2 x 10,000mm equals 20,000mm less Rise Factor of 1 day equals 10,000mm. This means the stretch of day 2 will present from 10,000mm to 20,000mm of the active year timescale.

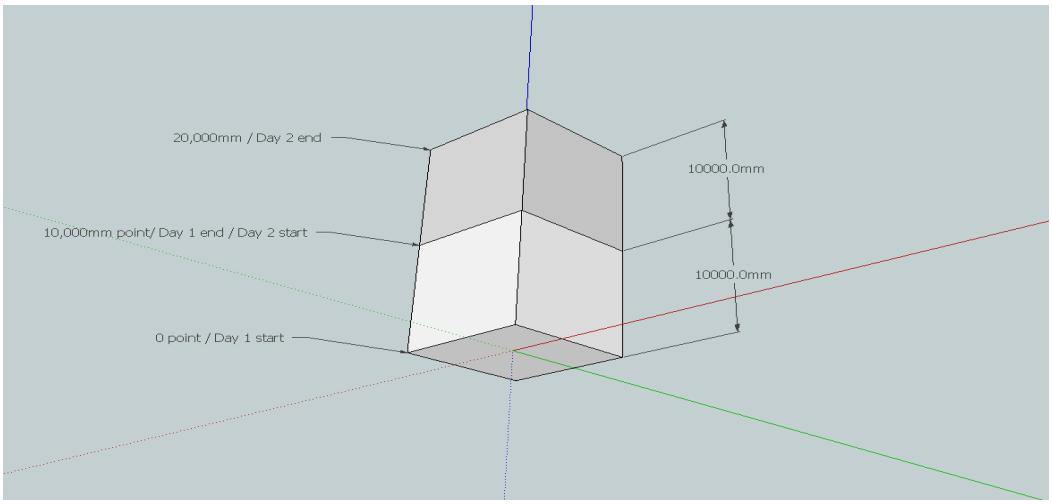

Figure 27: Start elevations representing time increment

I created a table with auto calculations to provide the elevation points of the first day of every time period of *Machinima*. The table (example following) allowed me to nominate the start points of an event (the date of occurrence) to create a model that can represent this state visually.

Table 11: Sample of Machinima *Active Year Z-Axis Start and Finish Positions*

Date	Numeric Value of Day	Numeric of 31 Dec 2009	Day of year number	Rise Factor in mm	Z-Axis Start Position millimetres	Z-Axis Finish Position millimetres
31/12/2009	40178.00	**40178.00**		**10000**		
1/01/2010	40179.00	**40178.00**	1.00	**10000**	0	10000
2/01/2010	40180.00	**40178.00**	2.00	**10000**	10000	20000
3/01/2010	40181.00	**40178.00**	3.00	**10000**	20000	30000
4/01/2010	40182.00	**40178.00**	4.00	**10000**	30000	40000
5/01/2010	40183.00	**40178.00**	5.00	**10000**	40000	50000

The time periods listed in the *Machinima* data were of equal, seven-day durations. In the project, I identified 26 such periods and I called these time periods "time-slabs". Each time-slab had a thickness of 10,000mm (representing the first day of occurrence) and through this means I established a visual separation between each period. I then placed the base of each time-slab vertically at an elevation along the Timescale on the z-axis. The elevation point for the time slabs was determined by the relative position above the defined point zero, or base of the Timescale. Through

such means, I created a table representing the time-slabs of *Machinima* and I allocated appropriate start date elevations on the vertical time axis (z-axis). These positions were as follows:

Table 12: Machinima *time-slab elevations*

A	B	C	D	E	F	G	H
Time Block	**Key Date**	**Numeric Day Number**	**Numeric of 31 Dec 09**	**Day of year number**	**Rise Factor in mm**	**Z-Axis position Start mm**	**Z-Axis position Finish mm**
31/12/2009	31/12/2009	40178.00	40178.00				
8-14 March	8/03/2010	40245.00	40178.00	67.00	10000	660000	670000
15-21March	15/03/2010	40252.00	40178.00	74.00	10000	730000	740000
22-28 March	22/03/2010	40259.00	40178.00	81.00	10000	800000	810000
29-4 April	29/03/2010	40266.00	40178.00	88.00	10000	870000	880000
5-11 April	5/04/2010	40273.00	40178.00	95.00	10000	940000	950000
12- 18 April	12/04/2010	40280.00	40178.00	102.00	10000	1010000	1020000
19 - 25 April	19/04/2010	40287.00	40178.00	109.00	10000	1080000	1090000
26- 2 May	26/04/2010	40294.00	40178.00	116.00	10000	1150000	1160000
3-9 May	3/05/2010	40301.00	40178.00	123.00	10000	1220000	1230000
10-16 May	10/05/2010	40308.00	40178.00	130.00	10000	1290000	1300000
17-23 May	17/05/2010	40315.00	40178.00	137.00	10000	1360000	1370000
24 - 30 May	24/05/2010	40322.00	40178.00	144.00	10000	1430000	1440000
31-6 June	31/05/2010	40329.00	40178.00	151.00	10000	1500000	1510000
7-13 June	7/06/2010	40336.00	40178.00	158.00	10000	1570000	1580000
14-20 June	14/06/2010	40343.00	40178.00	165.00	10000	1640000	1650000
21-27 June	21/06/2010	40350.00	40178.00	172.00	10000	1710000	1720000
28-4 July	28/06/2010	40357.00	40178.00	179.00	10000	1780000	1790000
5-11 July	5/07/2010	40364.00	40178.00	186.00	10000	1850000	1860000
12 - 18 July	12/07/2010	40371.00	40178.00	193.00	10000	1920000	1930000
19-25 July	19/07/2010	40378.00	40178.00	200.00	10000	1990000	2000000
26-1 August	26/07/2010	40385.00	40178.00	207.00	10000	2060000	2070000
2-8 August	2/08/2010	40392.00	40178.00	214.00	10000	2130000	2140000
9-15 August	9/08/2010	40399.00	40178.00	221.00	10000	2200000	2210000
16-22 August	16/08/2010	40406.00	40178.00	228.00	10000	2270000	2280000
23-29 August	23/08/2010	40413.00	40178.00	235.00	10000	2340000	2350000
30-5 September	30/09/2010	40451.00	40178.00	273.00	10000	2720000	2730000

In explanation the table operations was as follows:

Column A: Date Range of the events in the *Machinima* data sheet

Column B: Start Date of the date range of the *Machinima* data sheet

Column C: Numeric value of the date in Column B

Column D: Numeric value of the last day of the year preceding the active year

Column E: Column C less Column D [E=C-D]. This is the number of the day in Column B for the active year.

Column F: The rise factor or the numeric value in millimetres that represents one day in the model

Column G: Column E multiplied by value in Column F [G=E*F]

Column H: Column G plus 10,000mm to form an end date. The thickness of the time-slab is thus representative of one day for demonstrative purposes.

6.1.3 Event and Spatial Orientations

It was at this time that I started thinking deeply about future models. To locate a specific point indicating time and geo-location in relation to the x-, y- and z-axes of the model I would need to standardise the numeric format. In my model I converted time, or more specifically date, to a numeric format as in the preceding experiments. I subsequently adopted the same format in the model for geo-location. This is possible by interpreting the degrees, minutes and seconds of geo-coordinates as a numeric decimal value. In the test model following *Machinima* I explored this further.

I also had to consider what administrative tools—for example Microsoft Office—were available for general use to all CIF researchers for the ongoing and regular data capturing that can enable this kind of modelling. In this case, MS Excel fits well as the platform to become the Event Data Logger.

In the *Machinima* test case, I did not have the necessary data to locate an event in a specific geo-spatial location. Consequently, I represented events by groupings and colours within the same timeframe (time–slab). The following table explains the meaning of colours and identifying letters as experimental prototypes for testing recognition of type of event when viewed in the model. Such descriptors were extrapolated from the data.

Table 13: Event data from Machinima

Event	Descriptor/Group	Colour	Letter Code	Combo
Meeting	Meetings		M	M
Premise Due	Premise Due		PD	PD
Due Date for Artists	Critical Due Date		DD	DD
Start EDU kit	Educational Event		EDU	EDU
Collect Loan Agreement	Law Doc		LAW	LAW
Collect Artist Statement, Image and Credit Lines	Artist Information		AI	AI
Create copies of Video Works, floor plan etc. Draft EDU due	Video		V	V
Install works. Complete labels. Didactics due	Installation		IN	IN
Sally Dennis speaking about screens	Presentation		P	P
De-installation, return works and condition reports	Administrative Event		A	A

For practical reasons I decided on a system of dividing each time-slab into four quadrants to accommodate each event occurrence and the simultaneous (same date) occurrence of events. Each time-slab was vertically spaced to represent the time of occurrence by the altitude in elevation above the "0" ground level, and then populated with the event indicators as explained above.

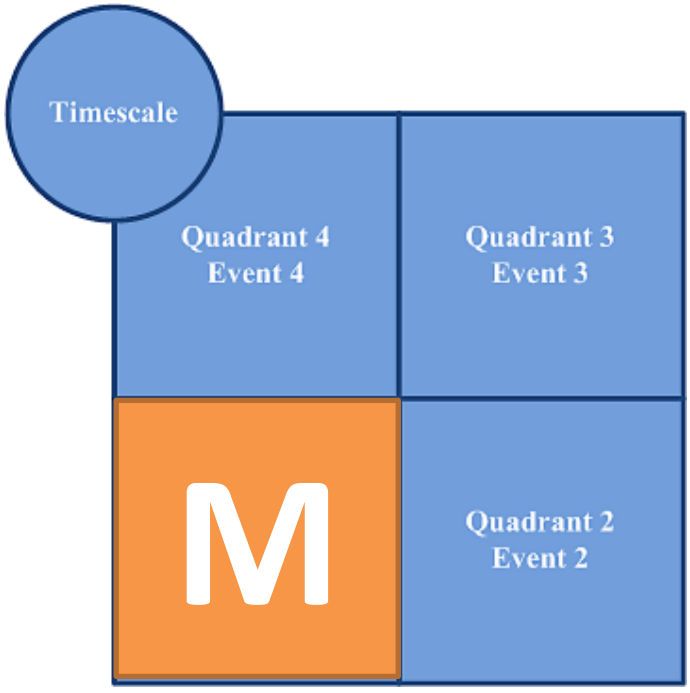

Figure 28: Top view of Machinima *quadrant allocation of events on the same time-slab*

6.1.4 Emerging *Machinima* Model and Visualisation

In sculpting the virtual *Machinima* model, the visual representation took the form of a high rise with each time-slab indicating a level (time) with activity (events).

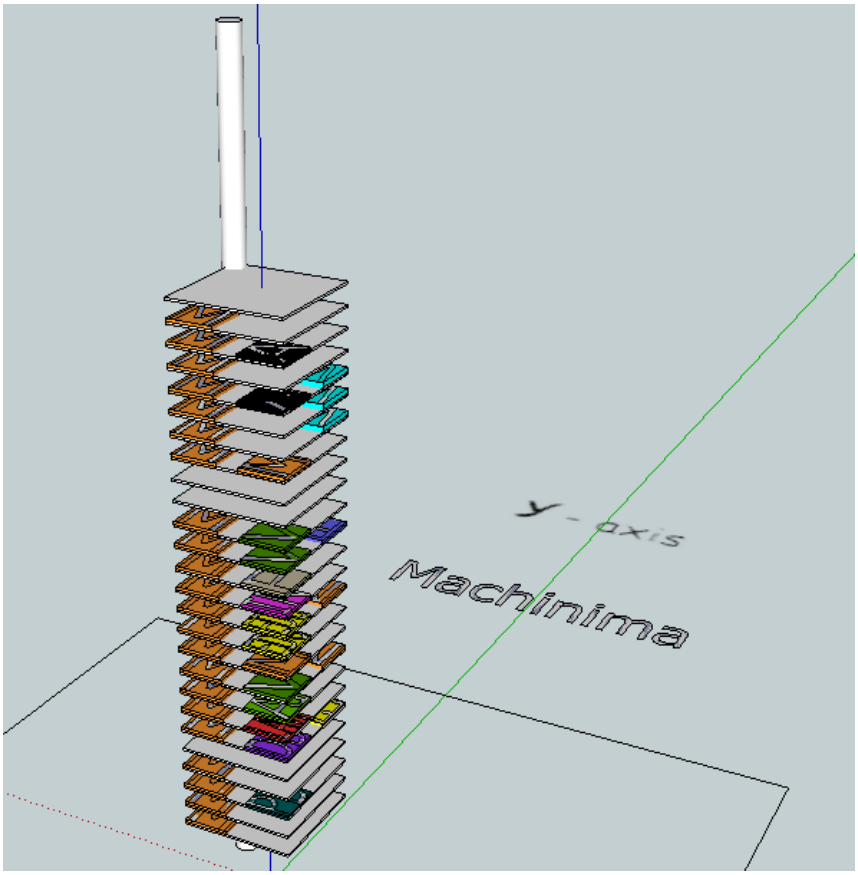

Figure 29: Machinima *quadrant allocation of events on the same time-slab*

After generating the virtual model I did further experiments with exporting the data as a *.stl file. This file type is used in the faculty to create models with laser cutting and rapid prototyping. The objective here was to manifest the model as a physical recreation. To me such a physical manifestation is an indicator of possibilities for future interactive design associations where the theoretical model of Hybrid Publication can transfer into representations of practice-led research by means of an artefact. This is not a direction I have explored in this research project. However I maintain that it is important to preface possible future applications of the concept in articulating creative practice-led research.

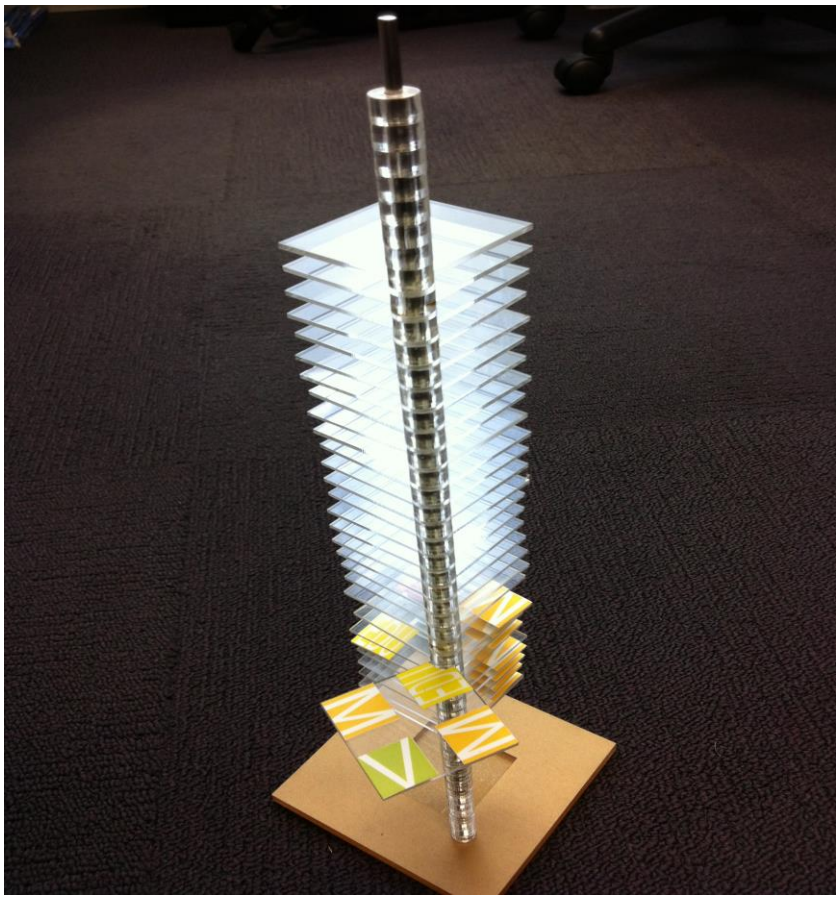

Figure 30: Machinima *laser cut model from *.stl file*

6.1.5 Comparison between Hybrid Publication and *Machinima* Test Model

The visual similarities between the theoretical model of the Hybrid Publication and the *Machinima* test case are striking. The *Machinima* data held no reference to geo-spatial coordinates and the representational model appeared very geometrical, almost architectural. However, the objective was to find a way to represent available data from a project with NTRO as a model, previously envisaged. The research experiment achieved this purpose, an important first step towards the Hybrid Publication Model taking form. This modelling experiment was also a first step in considering the representation of events by indicators in a quadrant method, which was devised because of a lack of geo-spatial data. As mentioned, the comparison of the mind image formed earlier and the outcome of the data representation presented sufficient similarities to establish a recognisable relationship. The similarities form the basis of the comparison in the figure below. Such an outcome was, to me, a clear indicator of positive progress in the project.

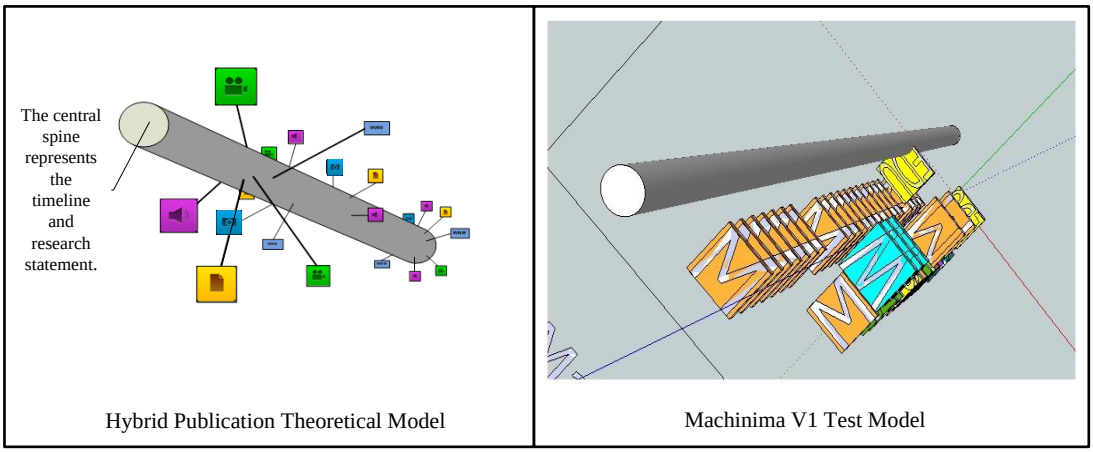

Figure 31: Comparison between Hybrid Publication Theoretical Model and Machinima *Test Model*

The key learning outcomes from the *Machinima* test were:

- The Timescale worked and should be kept in further developments,
- I needed to develop the data logger sheet in full.

The above points directed the next cycle of development to prioritise the following:

- Geo-locating the model to the geographic location of the study centre, and
- The temporal scaling for events.

6.2 CREATING THE MODEL THROUGH VARIOUS STAGES - TEST CASE 2

Table 14: Hybrid Publication Model V2 (SU 01 Experiment)

Test Case	Experiment	2D	3D	Comment
Test Case 2	SU 01 Exp		Yes	Event Objects and Attributes, Data Logger development, Data Flows for 2 and 3D

Such a basic resemblance of the Hybrid Publication Model as shown above from the *Machinima* data, was sufficient to allow for a next experimental development test case with data from the key documentative formats (foundational rich media elements) to develop the automated population of the 3D model elements.

In this experiment the basic approaches of the previous model (*Machinima*), particularly the temporal timescale, were still in use. However, the event objects, event logger and the association of evidential data (as attributions to the project) started a new modelling phase, more akin to the final outcome. In essence, some of the model building blocks and foundational elements were designed and coded to operate in the required manner.

In the long term, my objective is to allow researchers to collect data (logging of research activity and outputs) and then import or push such data (evidential trails) into a representational application that can document research evidence. I therefore needed to set up a developmental experiment that would, progressively, refine an approach necessary for mapping a virtual research project. As a result, in this experimental phase I moved towards:

- Developing the Evidence Logger to capture the data, and
- Using Ruby (API) programming code to interpret the data from the Evidence Logger as an application extension.

6.2.1 The Evidence Logger

The Evidence Logger (the data capture spreadsheet) is the data-capturing device where essential pieces of information are systematically gathered and logged. I had to write the code that interpreted data for modelling the software package. To do this I had to learn the programming language and, concurrently, develop the Evidence Logger. I achieved this through a four-step process: setting the goal, creating the data, writing the code to interpret the data, and returning a result. This approach represented a cyclic development stage.

6.2.2 Ruby Embedded Application Programming Interface (API)

Ruby is the embedded programming language API for SketchUp. This API can be used to customise or extend SketchUp to individual needs. Ruby is a general purpose programming language designed and developed by Yukihiro Matsumoto in the mid-1990s. This language has similarities with other programming languages such as

Python, Perl, Lisp, Dylan, CLU and Smalltalk. Programming paradigms include: object orientated, imperative, functional and reflective.

I had to accommodate, within the project, the writing of the Ruby code and creating suitable function within SketchUp for visualisation. I had assistance and guidance from Dr Jared Donovan, lecturer in Interactive and Visual Design at QUT, who both explained the concepts and demonstrated coding practices in short bursts to experimentally approximate simulated outcomes that I wanted to achieve. In the experiments around geo-locating the model, I again undertook a cyclical process starting with the idea, following with an experiment, reviewing that experiment, reflecting on the outcome, refining the outcome to provide a new approach, and then repeating the process until success or an acceptable outcome was reached. Below is an example of the process of cyclic Ruby code development for the models.

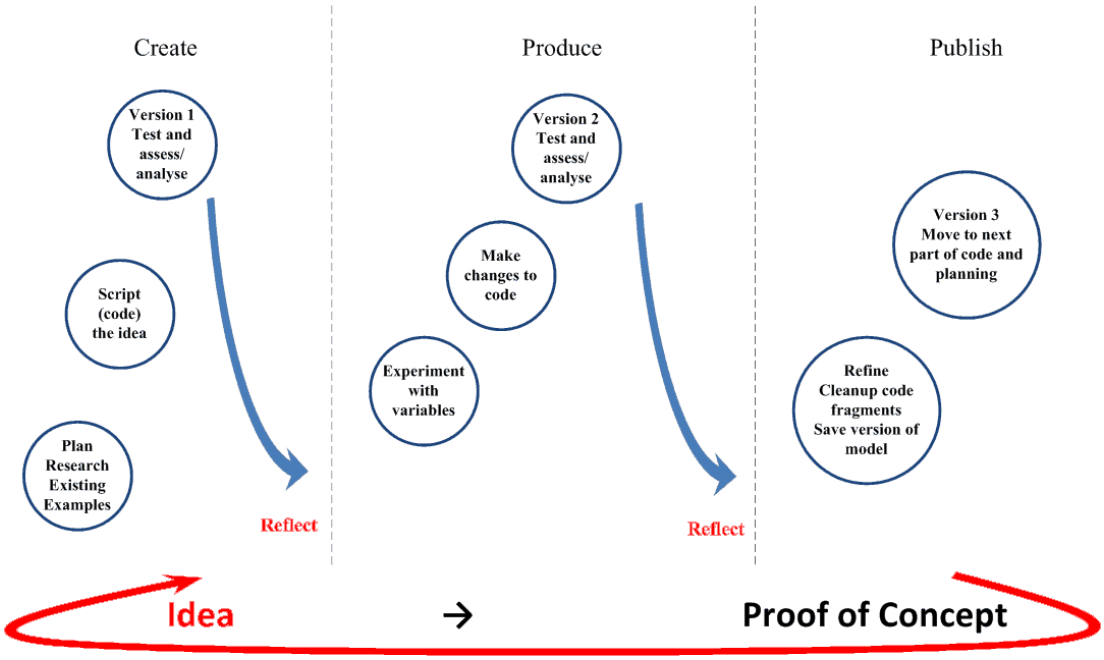

Figure 32: Cyclic development of Ruby code

6.2.3 Scripting Ruby Plugins and Extensions

As mentioned above, I had to learn the programming language. Using the Ruby API, I could program extra functions for the base application. These extensions to the program are referred to as "plugins" and use the file extension ***.rb**. To protect the

intellectual property and commercial value of the code, users can scramble it into a ***.rbz*** file type. I wrote my code as a ***.rb*** to allow continuous editing and enhancements. The cyclic approaches that I used in my research actioned a systematic development, or sandbox approach in writing of the code script. The progress of data development I kept in history so that I could progress, or retreat from, steps in the developmental program. This was achieved through simple file versioning.

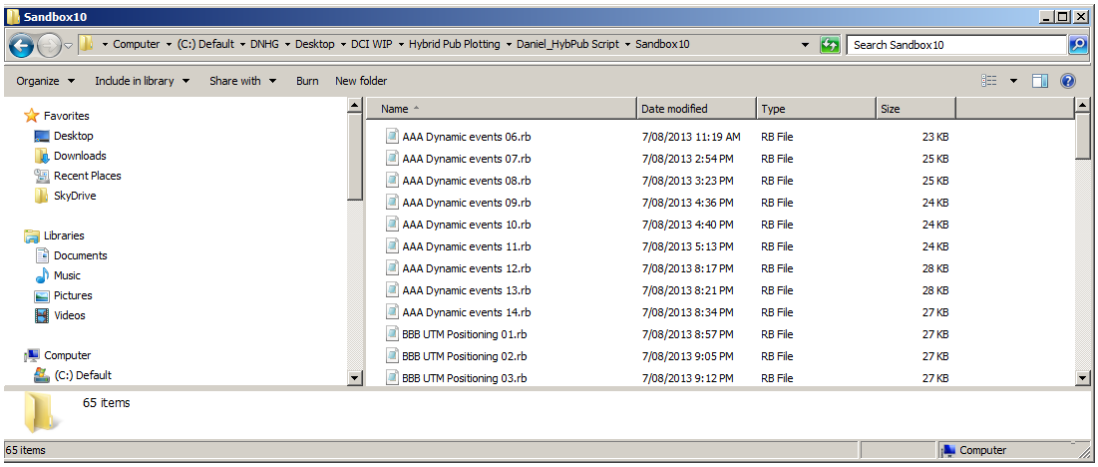

Figure 33: Screenshot example of versioning files

6.2.4 Developing the Evidence Logger

At the heart of the Hybrid Publication is the Evidence Logger. The Evidence Logger is an Excel workbook that calculates and distils down to a summary sheet which is exported as a comma delimited file or ***.csv*** file. This file is the database file from which data is loaded to the model. The modelling software code (that I wrote) interprets the values provided and the result is the actual model that is generated.

Basic experimentation in code writing, and determining the scale of time in the model provided the starting point of developing the Evidence Logger and model. To do this I had to create a set of data that represented different pieces of information to develop and test the generation of such a model. This was achieved through effectively writing my own code snippets that I later assembled into an application extension and plugin.

This data had to include:

- Geo location centre of the model,
- Timescale objects indicating start, end and duration for the model,
- Event data regarding what, when and where, and
- Attributes associated with the log as evidence such as images, text, video files or URLs.

The workbook consisted of a number of spreadsheets:

Table 15: Evidence Logger workbook data sheets

Spreadsheet Name	Purpose
Big Data	For the Researcher to enter a log of data into
CSV Master	Distillation of all data to provide the 3D modelling data for SketchUp This sheet is what is exported as the *.csv for SketchUp
Lists	Lists of all drop down box elements such as type of event
Key	A Sheet explaining all details regarding sheets, cells and formulas

6.2.5 Spatial Orientation of the Model

Spatial orientation to determine any single point in 3D space for the model is generated from data assigned to the three axes: x, y and z. In SketchUp, a single defined point in space is described as a construction point. Construction points are used to assist other modelling operations within the same model, such as defining the centre point of a circle and then positioning this circle according to the relevant geometric positioning defined by the three axes' values (see Appendix C Code Script – 3D Construction Point Script).

In my model the values of x and y are functional locating, based upon GPS location. The z-axis value represents the temporal positioning within the model: a position on the vertical axis that represents time demarcation. This value is the date of event

occurrence (start and end time) as previously described in the *Machinima* experiments. Both the location and the date are converted to a standardised numeric format. By doing so I could locate a single intersection point of the x, y and z-axis for the positioning of event-related data. The validity of this concept was confirmed in discussions with the software vendor on how the model might be auto-populated. The vendor had discussions with the creators as to the veracity of such an approach. The outcome of these discussions was an e-mail verification of my approach in the following words: "It is a very feasible concept" (see Appendix E).

As shown in Figure 34 below the models created within SketchUp for the Enhanced Geothermal Systems (EGS) explorations in Australia provide an example of using construction points to indicate position locations from GPS. The results were impressive cloud maps of gas exploration and drilling (Oliver 2008). In my research, I investigated this case for a number of reasons. One was to examine the use of construction points in creating a cloud map of positions. Another was to investigate the principals used for importing data from spreadsheets, via a *.csv file, into SketchUp using a bespoke *.rb plugin. This method is similar to what I have done to activate my model.

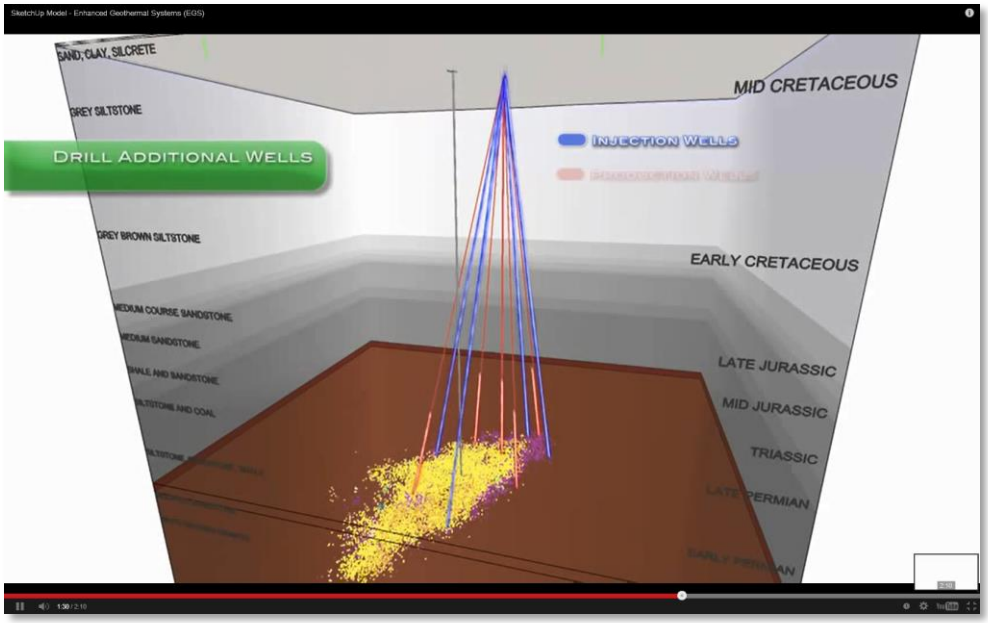

Figure 34: Screenshot of SketchUp EGS mapping (Oliver 2008)

To me each construction point modelled in the EGS case represented a specific event that occurred at a specific time; it was the "what" happened and the "when" and "where" did it happen?

6.2.6 X- & Y-Axis Positioning (Geo-location)

To determine the GPS location for events in my study I used the iPhone compass. Zandbergen, in the 2009 study "Accuracy of iPhone locations"(Zandbergen 2009), states that the iPhone uses a combination of A-GPS (Assisted GPS), Location-Based Services (LBS) and Wi-Fi location services, switching between these to provide positioning information. Overall the iPhone did not perform as well as dedicated GPS devices. However, for my study, the iPhone compass is sufficient to the type of work I am doing, and it is readily available to researchers and can display geo-spatial positioning. The positioning data I use in geo-location is also represented on Google Earth and Google Maps, which is the default mapping application of the iPhone.

I first capture the position of a location by using an iPhone compass. Screenshots can be taken with an iPhone by pressing the "home" and "sleep/power" button (on top of home) together at the same time. The phone's display will flash and then it stores the photo in your photo library. In the example below we can see the GPS location as DD/MM/SS South, DD/MM/SS East.

Figure 35: GPS location on iPhone

I then considered the interpretation of the North, South, West and East indicators when they are converted to numeric value and represented as positive (+) and negative (-) values that orientate the locating position correctly for the model. For my model, I preserved the hemispheres north and south as positive and negative values and also the west and east hemispheres as negative and positive values.

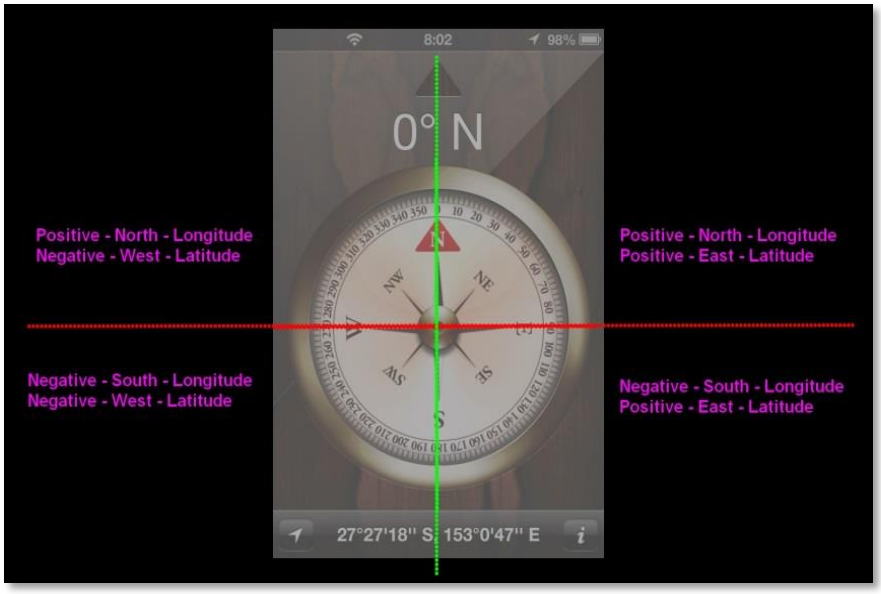

Figure 36: Positive negative hemisphere

I chose to use a Positive and Negative Hemisphere system in relation to the prime median, which is the most logical for the average person when forming a mind image of 2D representation of the world or the generally accepted world map view. In this way, I can use the x- and y-axis in relation to the East, West, North and South with differentiating positive (+) and negative (-) values to distinguish between these. The values are then entered into my worksheet with the appropriate positive (+) and negative (-) values as follows: -27, -27, -18 and 153, 0, 47.

Table 16: GPS entries into data logger sheet

Place	**Original - South**	**Degrees**	**Minutes**	**Seconds**
Daniel's Office	27.27.18S	-27	-27	-18
	Original - East	**Degrees**	**Minutes**	**Seconds**
	153.0.47E	153	0	47

As mentioned during the *Machinima* test, I would have to consider the single format of the numeric value between dates and location if I were to make a single reference point during modelling. For each dataset of positioning coordinates entered, a conversion is done from DD/MM/SS to a numeric value with eight decimal points. When the coordinates for each latitude and longitude are entered into my worksheet, a short formula converts the coordinates to a numeric decimal value.

Degrees + (Minutes/60) + (Seconds/3600) = Degrees in numeric decimal

Because:

1 Degree = 60 Minutes. 1 Minute = 60 Seconds. Thus 3600 Seconds = 1 Degree.

Example of latitude conversion to numeric value decimal: =C3+(D3/60)+(E3/3600)

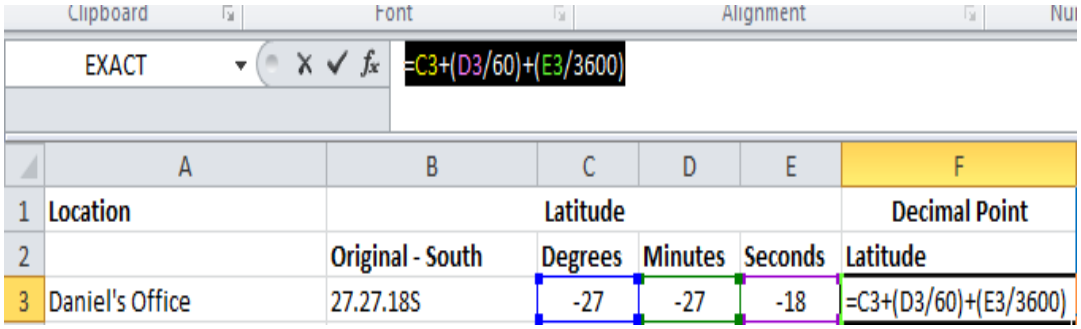

Figure 37: Screenshot of latitude and longitude conversion to decimal

The value provided by the calculation is thus -27.45500000. The same conversion is done for longitude and the result is a grid-reference type position, as indicated by the red disc in the graphic below.

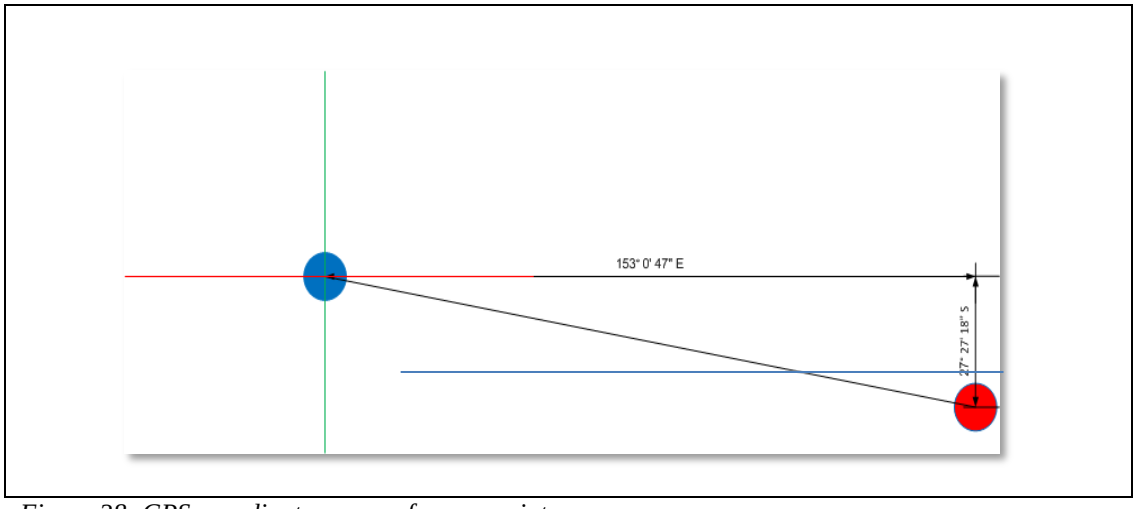

Figure 38: GPS coordinate cross-reference point

The locality of my office -27° -27’ -18″S, 153° 0’ 47″E will then, through the calculation, return the locality -27.4550000, 153.01305556, which can be called in Google Maps.

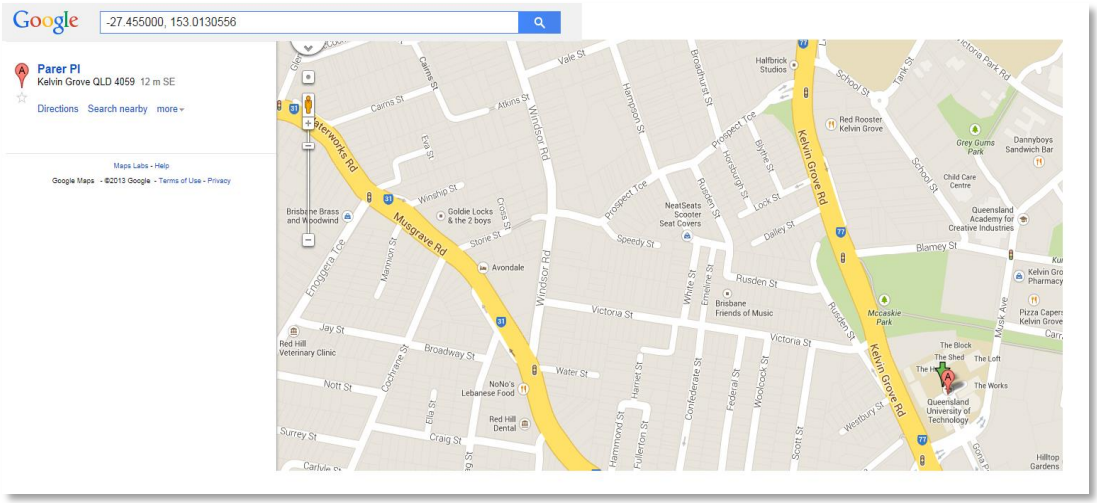

Figure 39: Screenshot of GPS location, Google Maps test

6.2.7 Geo-locating the Centre of the Study

Using the numeric decimal value format to convert the GPS coordinates and standardising the model numeric format, enabled me to provide the values for the x- and y-axis to which the study could be centred. The SketchUp API has a class of data called *Shadowinfo.* This class of data contains methods of extracting the shadow information of a model. The majority of such information exists in the model information, location and model information shadow dialogs inside the program. Relevant information keys that are maintained in SketchUp are:

- “City”, which can be found in (Model Info > Geo-Location > Set Manual Location), and
- “Country”, which can be found in (Model Info > Geo-Location > Set Manual Location).

For more information, see Appendix C Code Script - Geo-locating the Model Script.

I used this *shadowinfo* method to define the centre of my study, effectively locking the model to a specific geo-location for reference. In this way, I locate the timescale of the model, and in essence provide not just a physical lock to the centre of the study but a visual point of reference of locality in origin. In my case, I have used my office location as such a position, because that is where I have operated from as the base for my study. I would suggest this as the norm for most models to follow. The returned result confirmed the success of the script and I used it at the beginning of the modelling process. The Ruby console (return dialog for code analysis) would return the first line stating, "Geo-locating Model".

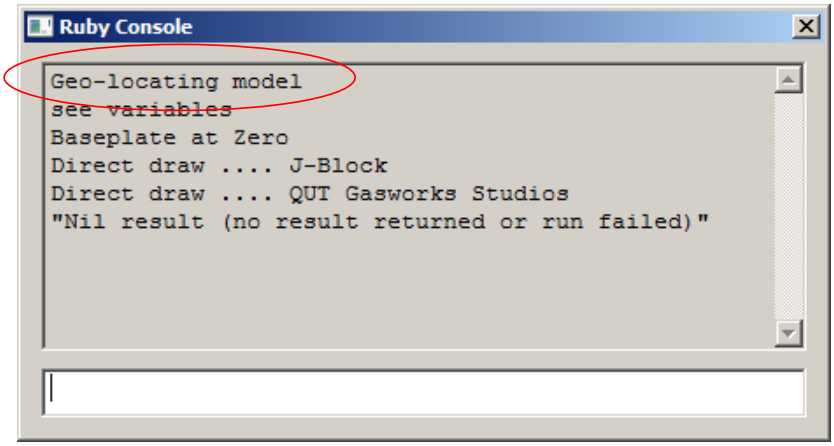

Figure 40: Ruby console proof: Geo-locating model feedback

This meant that, when the code script was tested with the application tool calling latitude/longitude of a point, at absolute 0 of the model the program would display a confirmation notice as follows:

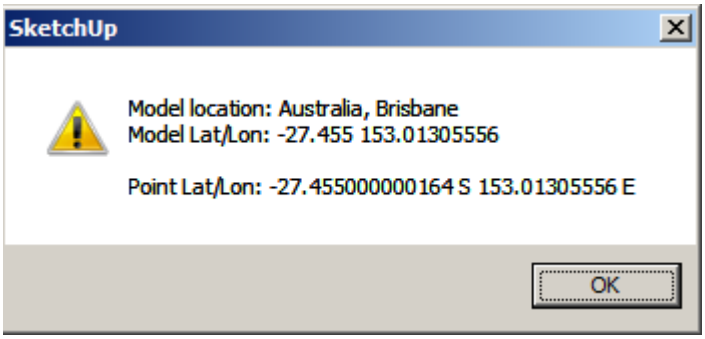

Figure 41: Screenshot geo-locating model confirmation message

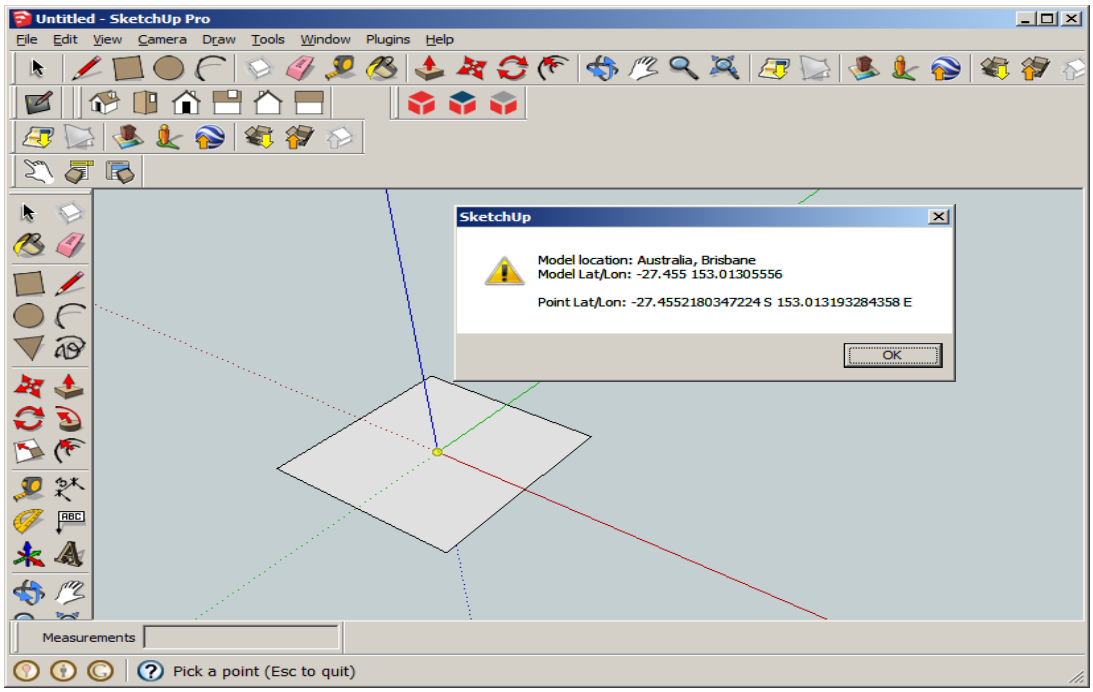

Figure 42: SketchUp: Geo-locating model confirmation 1

The final test in geo-locating the model and essentially addressing the "where" question was to run the location data and call the timescale cylinder to be drawn in the right place when acquiring the positional geo-tile through SketchUp from Google Earth:

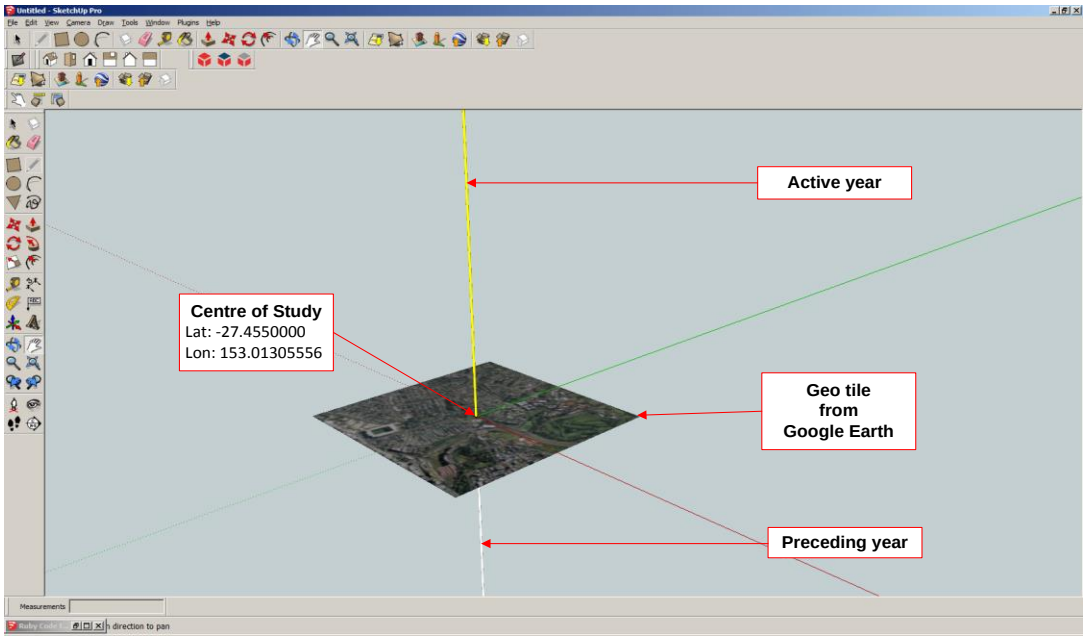

Figure 43: SketchUp geo-tile and geo-locating model confirmation 2

The method I used to accurately locate a position of geo-location within the model[12] became the standard for locating any object within the Hybrid Publication Model. There is a difference between locating the timescale cylinder and locating events within the model. The timescale is at a predetermined, fixed position classified as the centre of study. Events could appear at other locations. This meant that I also had to devise a method of locating events individually. I therefore wrote the plugin code to instruct the application to read such information from a file (see Appendix C - Code Script - *Code Strings to access data*).

6.2.8 Geo-location of Frequently Used Locations

I considered the possibility that there could be other predetermined sites of research activity. Examples of such locations are studios, theatres, galleries, schools and many more. In each such place repetitive activity, such as rehearsals and then the ultimate performance would be carried out. These places should be indicated, in the model, through the use of a reference marker.

The principal of geo-location informed my scripting that I used as test example QUT[13] localities representing the Design workshop (J-Block) at Gardens Point and the Gasworks Recording Studios in Newstead. These localities were indicated by a red disc centred on the geo-location, with a radius of 100m and a thickness of 20,000mm for a "real world" scale (see Appendix C - Code Script - *Geo Location for frequently used locations – hardcoding a position*).

[12] I converted Global Positioning System (GPS) coordinates to a compatible numeric format.
[13] QUT is located in the city of Brisbane Australia. Subsequent sites such as Newstead or J-Block at the Gardens Point Campus are also in Brisbane.

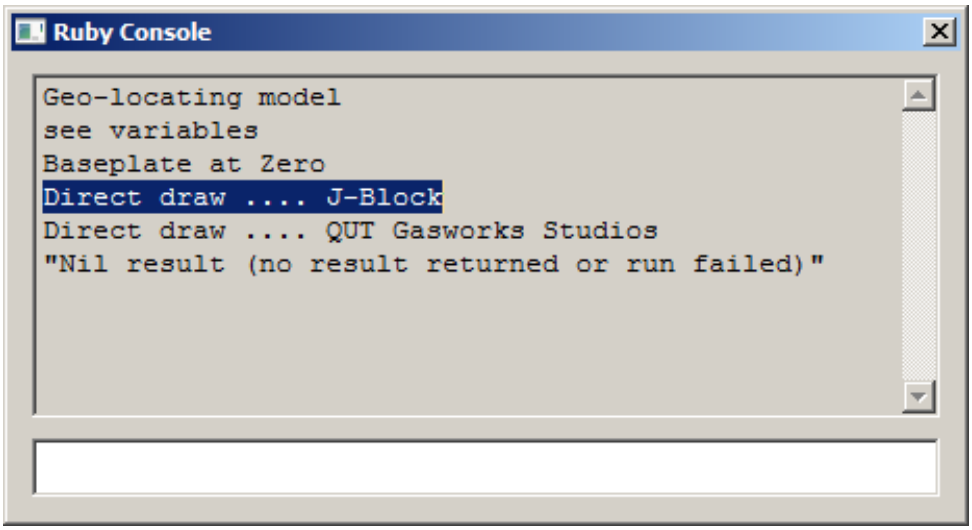

Figure 44: Ruby console proof: Direct draw location (J-Block) confirmation message

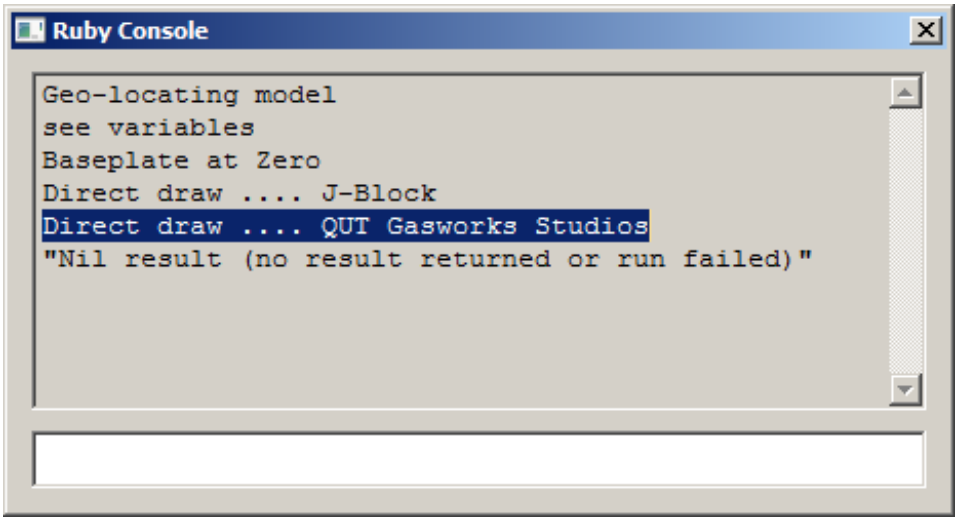

Figure 45: Ruby console proof: Direct draw location (Gasworks) confirmation message

I exported the model with fixed positions to Google Earth and cross-referenced the real-world location with the data (theoretical position) and determined that it was accurate to accept as a proof of concept.

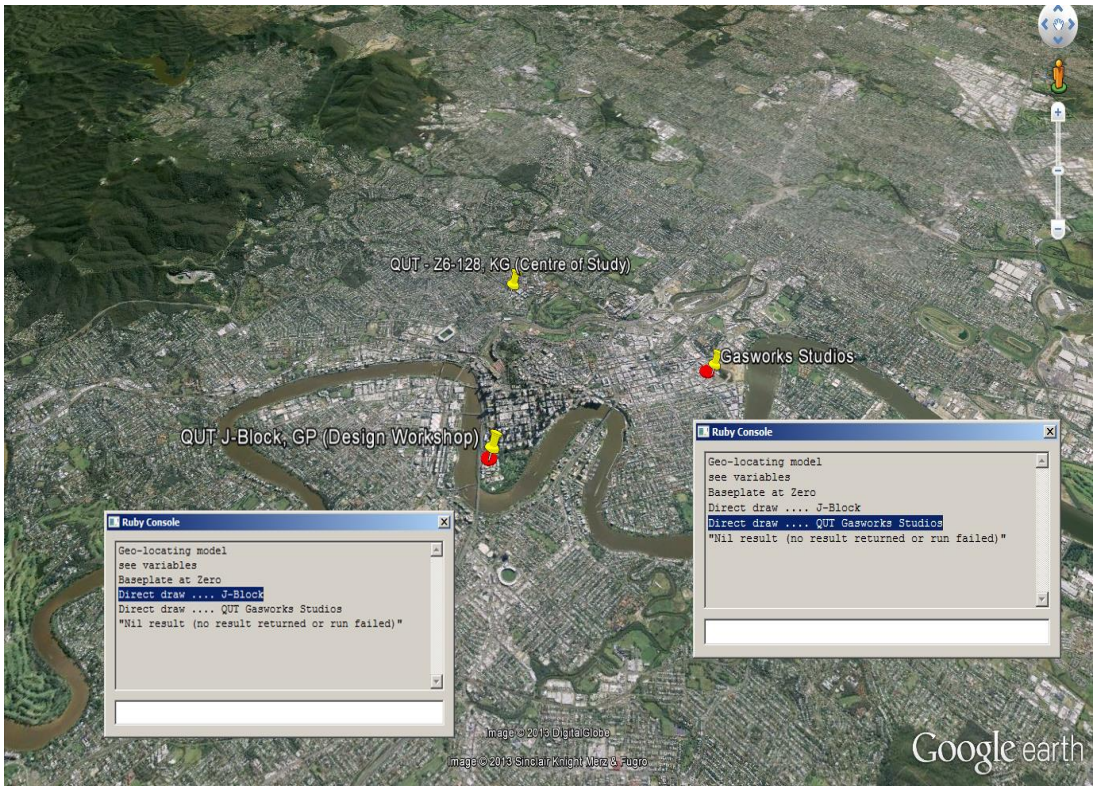

Figure 46: Google Earth direct draw location confirmations

In these experiments I locked in the central geo-location of the model and then assigned specific points of reference to the model for other repeating locations. In such a way, I could enter data into the Evidence Logger, which exported and read in the application, providing the visualisation I wanted to achieve. All these experimental developments were focussed at the x- and y-axis.

6.2.9 Representing Date as an Elevated Position

In Section 6.1.1 above (Making the Model), I explained how I derived a numeric system that represents date as a vertical elevated position. In the current experiment I use the same tables to convert date to numeric format, as I did in the *Machinima* model experiment.

Example of the time (date) conversion:

17/05/2013 = 41411.00

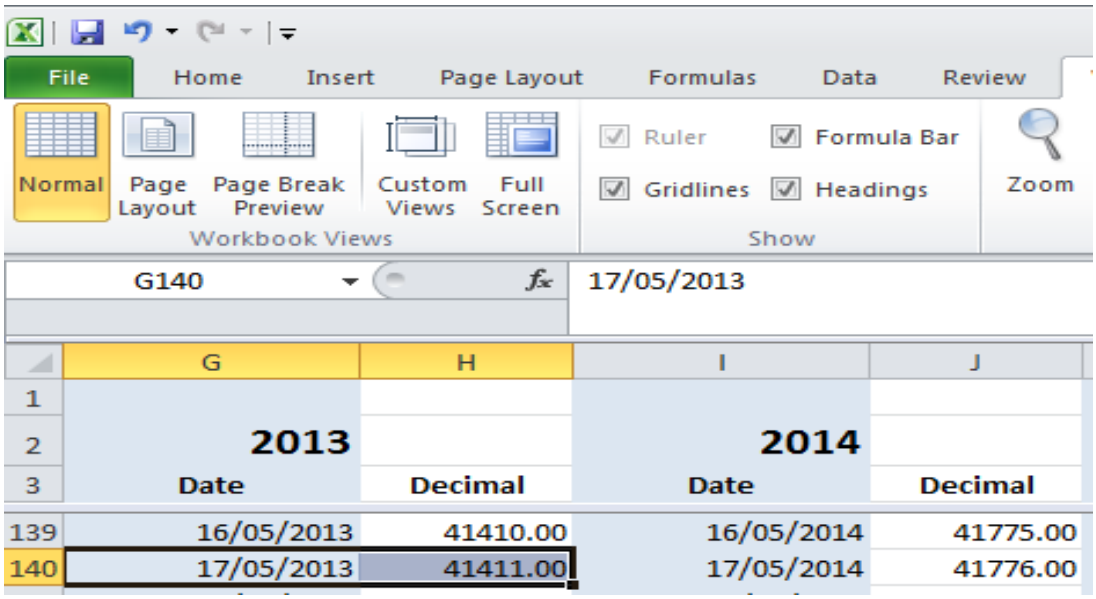

Figure 47: Screenshot of date numeric value conversion

6.2.10 Z-Axis Positioning (Time) Determining the Temporal Event Location in the Model

In my model I use the z-axis as the plotting axis to represent time. Time in this model defines the date in DD/MM/YYYY format. In other words, it provides the temporal localities associated with timescale and events. These localities (values) define "start time" points, "finish time" points and "duration time" stretch.

In the first experiment, I said time can be defined as infinity to zero to infinity, or $z = \infty : 0 : \infty$. This statement indicates that events come before and follow from a specific date. The date in question is a marker to orientate the 0 (zero) point; I chose to make this marker the point where the preceding year ends and the active year starts. The active year is the year chosen as the active project year. My DCI Research Project 2 has the active year of 2013. This active year starts at 01 January 2013 and finishes on 31 December 2013. Zero equals the start of the active year, in this case 2013. In this way, anything before 2013 is represented below zero and anything from 2013 is after zero.

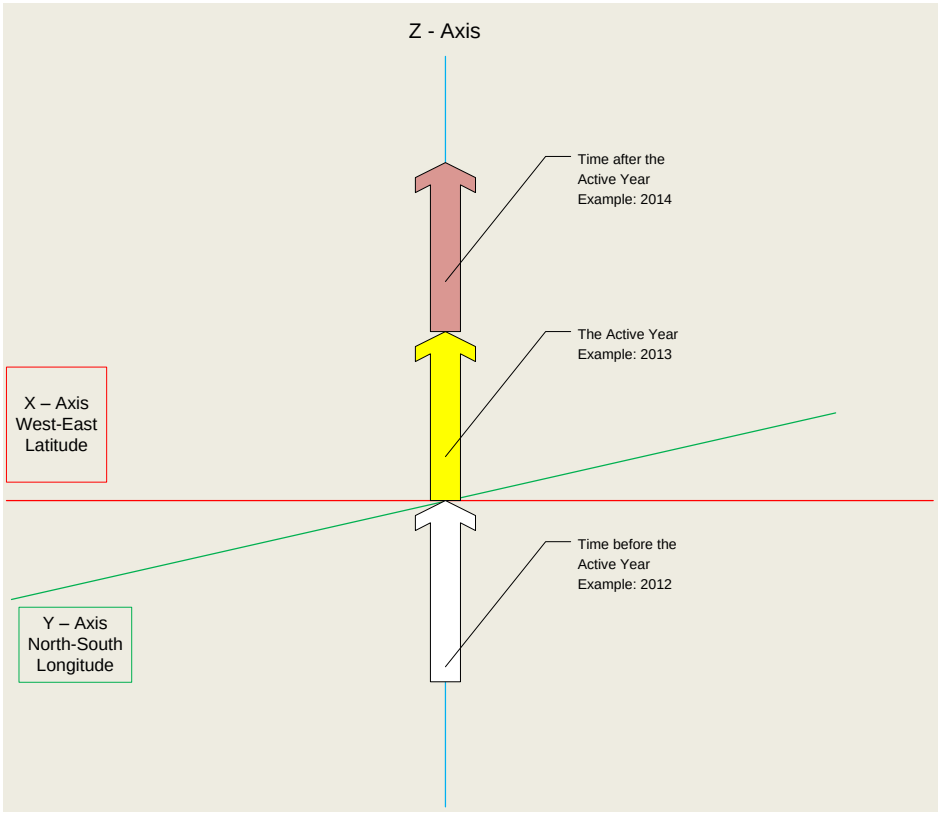

Figure 48: Timescale explanation

I have also repeated the principals of the active year as a timescale. To do so, I simulate the timescale with a cylinder that rises (positive extrusion) on the z-axis from zero as the "active year". Anything that has occurred before zero is below zero. The length of timescale cylinder represents a year (12 Months = 365 days). For more information about defining a year in code, see Appendix C - Code Script - *Defining a Year in Code*.

This value is used in the extrusion of the cylinder that represents the active year. In the explanation below a circle is added to the model, a face plane is added, and the plane is extruded for the value of one year (see Appendix C - Code Script – *Active Year extrusion script*).

The year defined in this model is 3650m, representing a year of 365 days, each day with a vertical space stretch value of 10,000mm. Such an enormous scale is necessary to provide a model that is visible on a global modelling scale.

6.2.11 Event Dates

Each event occurrence will have two dates that act as the temporal boundaries. These two dates are the start date and the finish date of each event. The variance between these two temporal positions is the duration (stretch) of the event. The start date provides the vertical elevation of the event and is the temporal (z-axis) positioning used in the 3D geometry (x, y, z) to position such an event. As previously stated I use Excel as the database (6.2.4 Developing the Evidence Logger), with a standardised numeric value to represent time (date) and with the date numeric tables I created there is always a variance of 1.00 between a series of consecutive dates as indicated in the table below.

Table 17: Sample date number value variances

Date	Number Value	Variance
1/01/2013	41275.00	
2/01/2013	41276.00	1.00
3/01/2013	41277.00	1.00
4/01/2013	41278.00	1.00

The increment variance of 1.00 per day allows me to nominate the particular year date. I use 20 March 2013 in the following demonstration. The numeric value of the chosen date (20 March equals 41353.00) less the numeric value of 31 December of the year before (31 Dec 2012 equals 41274.00) equates to the day number of the chosen date in the year. For example: 41353.00 less 41274.00 equals 79.00 less 20 March is day 79 of 2013. The following table is an example of the data calculation table that can be made.

Table 18: Examples of date to day of year number

Date	Number value of date	Number value of 31 Dec 2012	Day of year (2013) number
10/02/2013	41315.00	**41274.00**	41.00
2/03/2013	41335.00	**41274.00**	61.00
17/03/2013	41350.00	**41274.00**	76.00
20/03/2013	41353.00	**41274.00**	79.00

Now I use the multiplication factor of the timescale (10,000mm per day) to determine the elevation of the event in order to represent its occurrence in time, or, in other words, its z-axis elevated position for the model. To determine the vertical start point or "z-axis position" of the event on a specific date in the model, I multiply the day of year with the multiplication factor. In the example below I show the process for two chosen dates: 1 January 2013 and 20 March 2013.

Enter the start date (A)

A	B	C	D	E	F
1/01/2013	41275.00	**41274.00**	1.00	10000	10000
20/03/2013	41353.00	**41274.00**	79.00	10000	790000

The spreadsheet, through formatting and setting the numeric value, provides the numeric decimal number of the start date (B)

A	B	C	D	E	F
1/01/2013	41275.00	**41274.00**	1.00	10000	10000
20/03/2013	41353.00	**41274.00**	79.00	10000	790000

Consider the numeric decimal number of the end date of the preceding year (C)

A	B	C	D	E	F
1/01/2013	41275.00	**41274.00**	1.00	10000	10000
20/03/2013	41353.00	**41274.00**	79.00	10000	790000

Calculate the variance between the event date (B) and the preceding year-end date (C): B – C = D

A	B	C	D	E	F
1/01/2013	41275.00	**41274.00**	1.00	10000	10000
20/03/2013	41353.00	**41274.00**	79.00	10000	790000

Multiply day of year number (D) with the timescale multiplication factor (E) to produce the z-axis position (F): D x E = F

A	B	C	D	E	F
1/01/2013	41275.00	**41274.00**	1.00	10000	10000
20/03/2013	41353.00	**41274.00**	79.00	10000	790000

In this way, I created a quick-reference table or date calculator (Date Calc) for the data logger workbook.

Table 19: Excerpt from Date Calc sheet

Date	Numerical value of date	Numerical 31 Dec 2012	Day of year number	Multiplication factor in mm	Z-axis position
31/12/2012	**41274.00**	**41274.00**			
1/01/2013	41275.00	**41274.00**	1.00	10000	10000
2/01/2013	41276.00	**41274.00**	2.00	10000	20000
3/01/2013	41277.00	**41274.00**	3.00	10000	30000
4/01/2013	41278.00	**41274.00**	4.00	10000	40000
5/01/2013	41279.00	**41274.00**	5.00	10000	50000
15/03/2013	41348.00	**41274.00**	74.00	10000	740000
16/03/2013	41349.00	**41274.00**	75.00	10000	750000
17/03/2013	41350.00	**41274.00**	76.00	10000	760000
18/03/2013	41351.00	**41274.00**	77.00	10000	770000
19/03/2013	41352.00	**41274.00**	78.00	10000	780000
20/03/2013	41353.00	**41274.00**	79.00	10000	790000

The key learnings from the experiments with the data sheet for the model is summarised in the following points:

- The importance of the Evidence Logger development is noted;
- The principal of hard coding geo-locations as the centre of the model, as well as repeating locations, can be used effectively and accurately;
- The temporal positioning and duration formulae successfully provide data to locate construction points.

Conclusively these preceding data preparations provided the starting point of the next set of experiments with event objects and additional attributes to facilitate evidential data.

6.2.12 Experiments with Event Objects and Adding Attributes

After experimenting with and creating geometric objects for representing events, and after determining how to best represent a period of time, I decided to indicate the duration of events with a cylindrical object. The typical separation between the start and finish dates of an event provides the stretch, or in modelling terms, an extrusion, that can illustrate duration at a glance. The figure below demonstrates how I used the extrusion of a cylinder to indicate the duration of events.

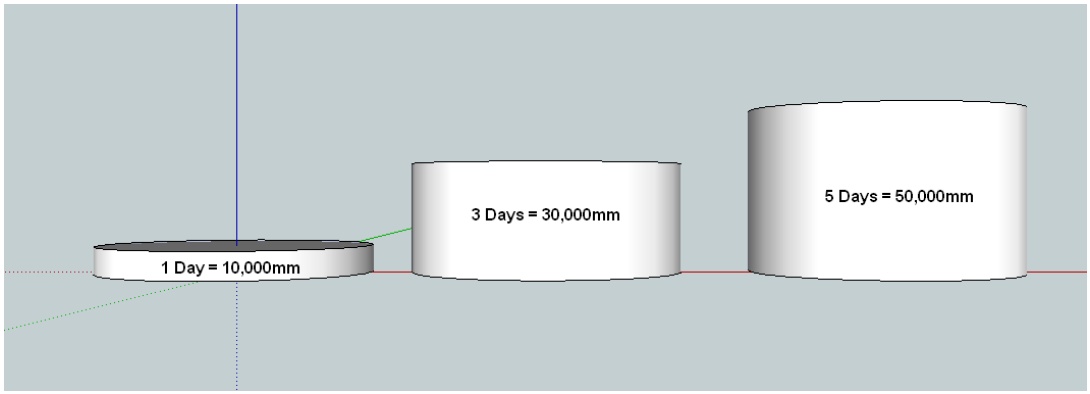

Figure 49: Cylinders representing days of duration

Furthermore, I experimented with colour and found that it allowed for a quick review of events and project evidence at a glance. I first used this method to represent the type of event. The type of event, in turn, pointed to the type of rich media association. In the initial, theoretical Hybrid Publication Model, I used colour and icons to represent rich media; these are set out below.

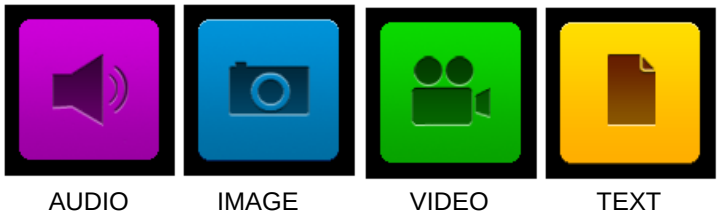

Figure 50: Icons representing rich media elements

In the modelling process, I had to decide how different events were best represented through rich media or evidential attributes. At the same time, I considered how data

could be entered into the Evidence Logger and then interpreted through the developing code to form the visualisation. The outcome was:

a. A predetermined list of possible events in the Evidence Logger that could appear in a dropdown menu within the Big Data Sheet. The elements included for this test model were: Timescale, Audio, Image, Video, Text, Live Performance, Film, Interview, Experiment, Exhibition, Research, Supervisor, Meeting and Cube (generic test object).

b. The development of a series of columns where the basic rich media elements data could be indicated and linked to. I was inspired by the 2D BEEDOCS data administration list (the direct event edit interface) where four columns—Link, Notes, Image and Movie—carry all the necessary data.

Table 20: BEEDOCS attribute columns

Link	**Notes**	**Image**	**Movie**
Any URL	Short text	An image	*.mov

For my model the same columns exist with the following definitions:

Table 21: Hybrid Publication attribute column definitions

Notes	**Link**	**Image**	**Movie**
Enter notes: short text descriptor	Enter hyperlink to a file such as *.docx, *.pdf or any file your computer can open	Enter hyperlink for an image, online or offline (if offline access restrictions might prevent the file from opening)	Enter hyperlink for a movie e.g. a file or a YouTube link (if offline access restrictions might prevent the file from opening)

I developed a method for associating the evidential file or place with the event by automatically populating the model from data provided, rather than having to script each association individually. This I achieved through a sequential process:

1. Script a call for the data from a specific column of the Evidence Logger (spreadsheet),
2. Associate the data with an object that represents that type of event, and
3. Use a methodology of differential event type arguments <if> or <elsif> to differentiate between event types and the associated action of attribution under each type of event argument.

The model ***.rb** was already scripted to read data from a file. I now had to expand on the columns to be read, such as: type of event, text notes about the event, and links to sites and locations holding documentative evidential trails. The model scripting reflecting this action can be seen in Appendix C - Code Script–*Call data from a specific location.* I also called file locations defining representative components. Scripting reflecting this action can be seen in Appendix C - Code Script–*Shapes File Path.*

6.2.13 Methodology of Differential Event Type Arguments <if> or <elsif>

In the process of modelling project data for the Hybrid Publication, several "event types" can be identified, such as "experiment, meeting, public performance etc". To create the different event objects I used the definition statements with a variable approach. This means I provided a script argument by "type of event" that told where the data would be read from, the colour of the object and where to find evidential data relating to the object. The scripting argument was written in an "if" <if> and "if not" <elsif> style. This scripting can be seen in Appendix C - Code Script–*Methodology of differential event types*.

For each type, the code needed to define the event objects and actions that would occur in a data attribute method, a process that, when completed, was based on the data read from the source file. The modelling code script actioned the process by

retrieving relevant data from the source file (evidence logger converted to a comma delimited *.csv file) at the specified file path, data row and specified column in terms of the call by the code script.

The process was as follows:

1. Define the type of event;

2. Instruct the columns of data to be read from the source file;

3. Set an array reading the x-, y- and z-axis data (longitude, latitude, start date);

4. Create a construction point at the x, y, z position;

5. Set an array of duration that equates to the stretch of the event;

6. Define the event object as a circle where the centre point is the same as the positional array point;

7. Add a face to the circle and stretch (extrude) this with the value of stretch (duration);

8. Colour the cylinder according to the event type;

9. Add a construction point offset from the positional point that carries an attribute of text (this can be used as a short note or name descriptor if required); and

10. Add a construction point attribute of link. This attribute can be used for any URL or hyperlink situation. It will cause the “open URL” tool to be available to any object in the model that has data of this nature when the user right-clicks on the object. This URL link attribute is based upon the freely available script written by Didier Bur and refined by Dr Jared Donovan and myself.

The end result of the data required to populate the model is as follows:

Table 22: Model data requirements

Event	Personal event ID—not used by anything else
Type of Event	Select a type of event from the dropdown box
Start Date	Enter date that event started (DD/MM/YYYY)
End Date	Enter date that event finished (DD/MM/YYYY)
Lat D	Degrees of Latitude
Lat M	Minutes of Latitude
Lat S	Seconds of Latitude
Latitude	Latitude value in numerical decimal format
Long D	Degrees of Longitude
Long M	Minutes of Longitude
Long S	Seconds of Longitude
Longitude	Longitude value in numerical decimal format
Notes	Enter notes—short text descriptor
Link	Enter hyperlink to a file such as *.docx, *.pdf or any file your computer can open
Image	Enter hyperlink for an image, online or offline (if offline access restrictions might prevent the file from opening)
Movie	Enter hyperlink for a movie e.g. a file or a YouTube link

The data logger sheet and its data flow relationships could now be traced as follows:

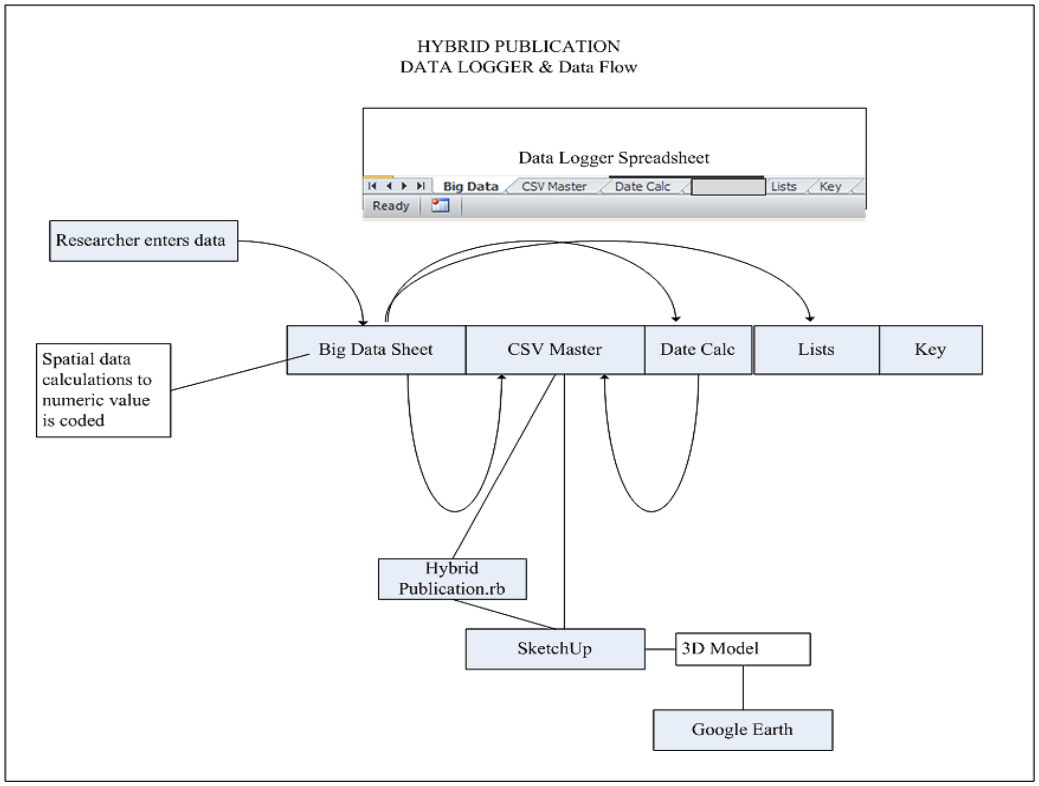

Figure 51: Data flow from data logger to SketchUp 3D dynamic visualisation

I presented this data flow in my milestone seminar:

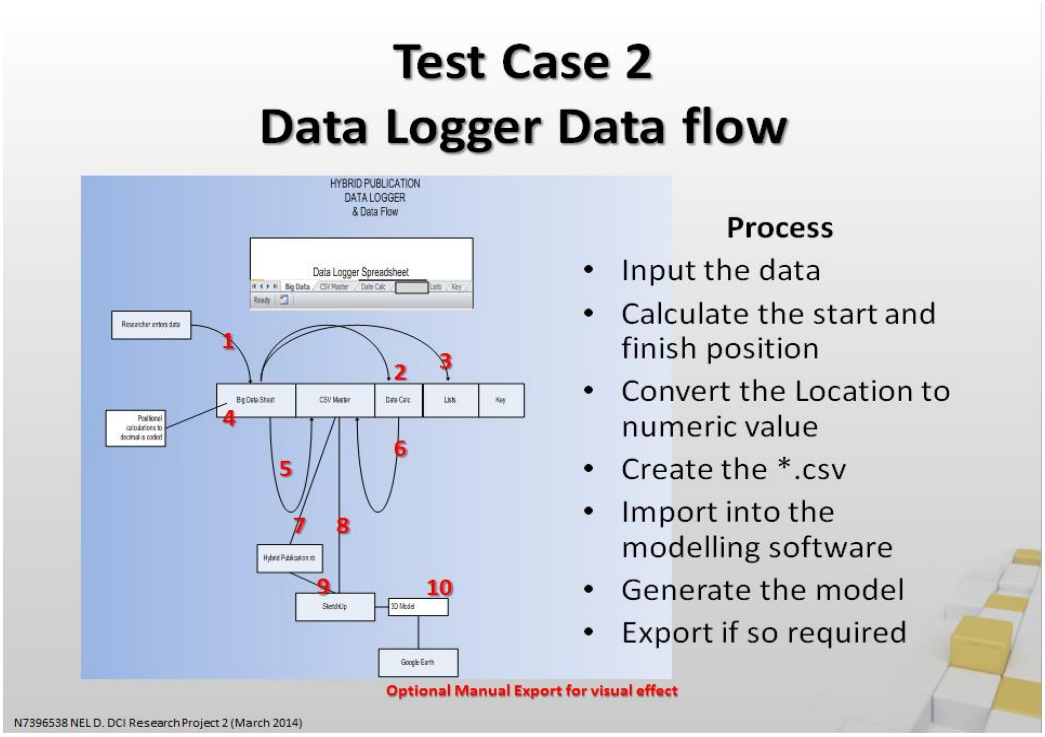

Figure 52: Screenshot of Data Logger Data Flow from DCI final presentation 28 March 2014

6.3 EXPERIMENTS - TEST THE MODELLING CONCEPTS

The following modelling tests were conducted as proof of concept:

Table 23: 3D POC tests

Test Case	Experiment	2D	3D	Comment
Test Case 2	H-Pub Test 1		X	POC Test - Multiple events at a single location
Test Case 2	H-Pub Test 2		X	POC Test - Multiple events at multiple locations
Test Case 2	H-Pub Test 3		X	POC Test - Events with rich media

In the next three sections I provide the experimental data table used for the experiment, and then I present a screenshot that depicts the resulting output. This screenshot provides the evidence that confirms the successful processing of the modelling experiments.

6.3.1 H-Pub Test 1: Data and 3D Modelling Test for Different Events Located at a Single Location

Table 24: H-Pub Test 1 dataset

Event	Start Date	End Date	Latitude	Longitude	Notes
Timescale	0	365	-27.455	153.0131	Daniel's Office
Cube	0	1	-27.455	153.0131	Daniel's Office
Audio	13	14	-27.455	153.0131	Gasworks
Video	19	20	-27.455	153.0131	Daniel's Office
Text	24	25	-27.455	153.0131	J Block GP
Image	26	27	-27.455	153.0131	Hello Image

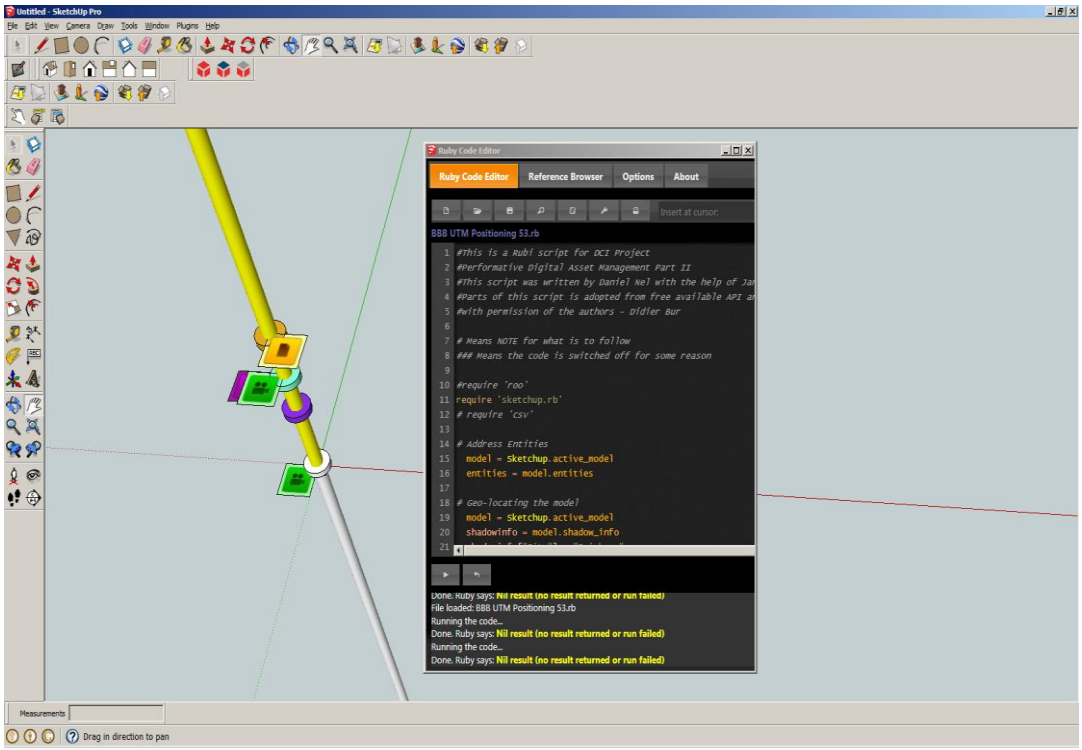

Figure 53: Model from data logger to SketchUp 3D dynamic visualisation

6.3.2 H-Pub Test 2: Data and 3D Modelling Test for Different Events Located at Multiple Predetermined Positions

Table 25: H-Pub Test 2 dataset

Event	Start Date	End Date	Latitude	Longitude	Notes
Timescale	0	365	-27.455	153.0131	Daniel's Office
Cube	0	1	-27.455	153.0131	Daniel's Office
Audio	13	14	-27.4519	153.0433	Gasworks
Video	19	20	-27.455	153.0131	Daniel's Office
Text	24	25	-27.4764	153.0269	J Block GP
Image	26	27	-27.4764	153.0269	Hello Image
Cube	14	16	-27.4519	153.0433	Gasworks
Audio	31	35	-27.4519	153.0433	Gasworks
Video	36	40	-27.455	153.0131	Daniel's Office
Text	41	45	-27.4764	153.0269	J Block GP
Image	46	50	-27.4764	153.0269	Hello Image
Cube	31	35	-27.4764	153.0269	J Block GP
Audio	59	68	-27.4519	153.0433	Gasworks
Video	66	76	-27.455	153.0131	Daniel's Office
Text	73	83	-27.4764	153.0269	J Block GP
Image	78	88	-27.4764	153.0269	Hello Image

Cube	59	68	-27.4519	153.0433	Gasworks
Audio	90	99	-27.4519	153.0433	Gasworks
Video	104	106	-27.455	153.0131	Daniel's Office
Text	107	111	-27.4764	153.0269	J Block GP
Image	112	113	-27.4764	153.0269	Hello Image
Cube	90	94	-27.4764	153.0269	J Block GP
Audio	120	121	-27.4519	153.0433	Gasworks
Video	124	125	-27.455	153.0131	Daniel's Office
Text	126	127	-27.4764	153.0269	J Block GP
Image	129	130	-27.4764	153.0269	Hello Image
Cube	120	122	-27.455	153.0131	Daniel's Office
Cube	364	365	-27.455	153.0131	Daniel's Office

The image below show the modelling test for different events located at a multiple predetermined positions. These predetermined positions were coded in accordance with the explanation in section 6.2.8

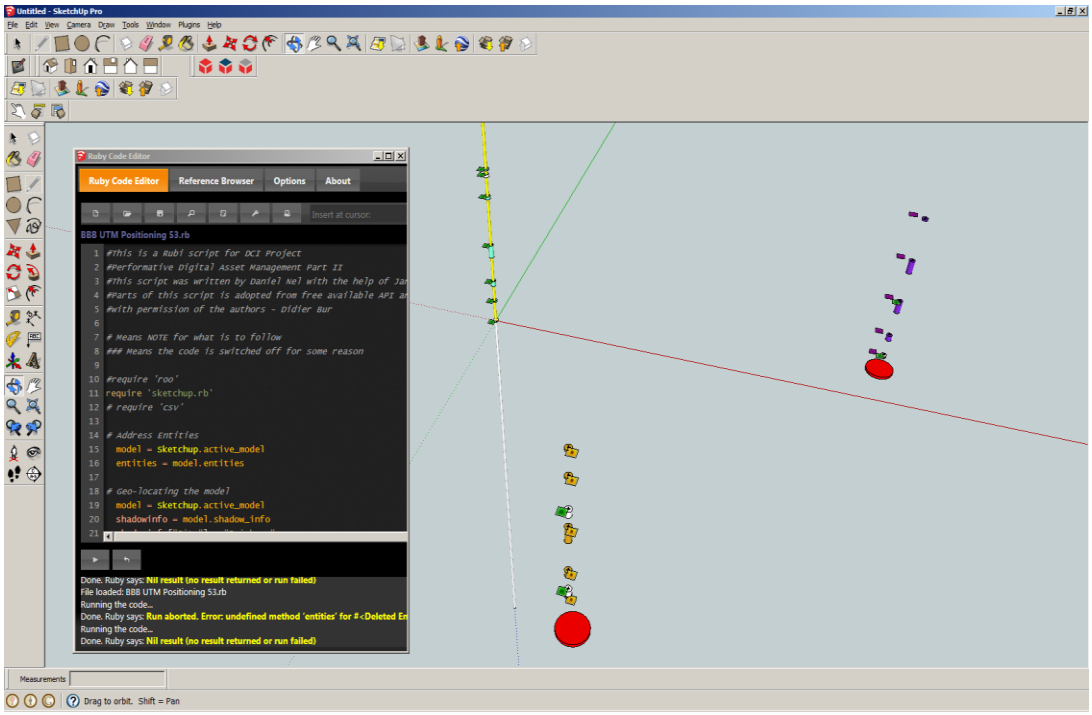

Figure 54: Model of multi events at predetermined locations from data logger to SketchUp 3D

6.3.3 H-Pub Test 3 Show several events with attached Dynamic attribute data

I used the "URL Open" command string to execute the association of a video file (or any media file) with an event object. This created a pathway to an evidential element or, as argued, an attribute of a project.

Table 26: H-Pub Test 3 dataset events with a rich media attribute

Event	Start Date	End Date	Lat	Lon	Notes	Movie
Timescale	0	365	-27.455	153.01306	Daniel's Office	
Cube	0	1	-27.455	153.01306	Daniel's Office	http://youtu.be/_dmliLIBcPw
Audio	13	14	-27.45194	153.04333	Gasworks	http://youtu.be/_dmliLIBcPw
Video	19	20	-27.455	153.01306	Daniel's Office	http://youtu.be/_dmliLIBcPw
Text	24	25	-27.47639	153.02694	J Block GP	http://youtu.be/_dmliLIBcPw
Image	26	27	-27.47639	153.02694	Hello Image	http://youtu.be/_dmliLIBcPw

The image below shows the coding on the left, the model generated in the centre and the attribution (evidential file) on the right. In this case the attribution file is a video file.

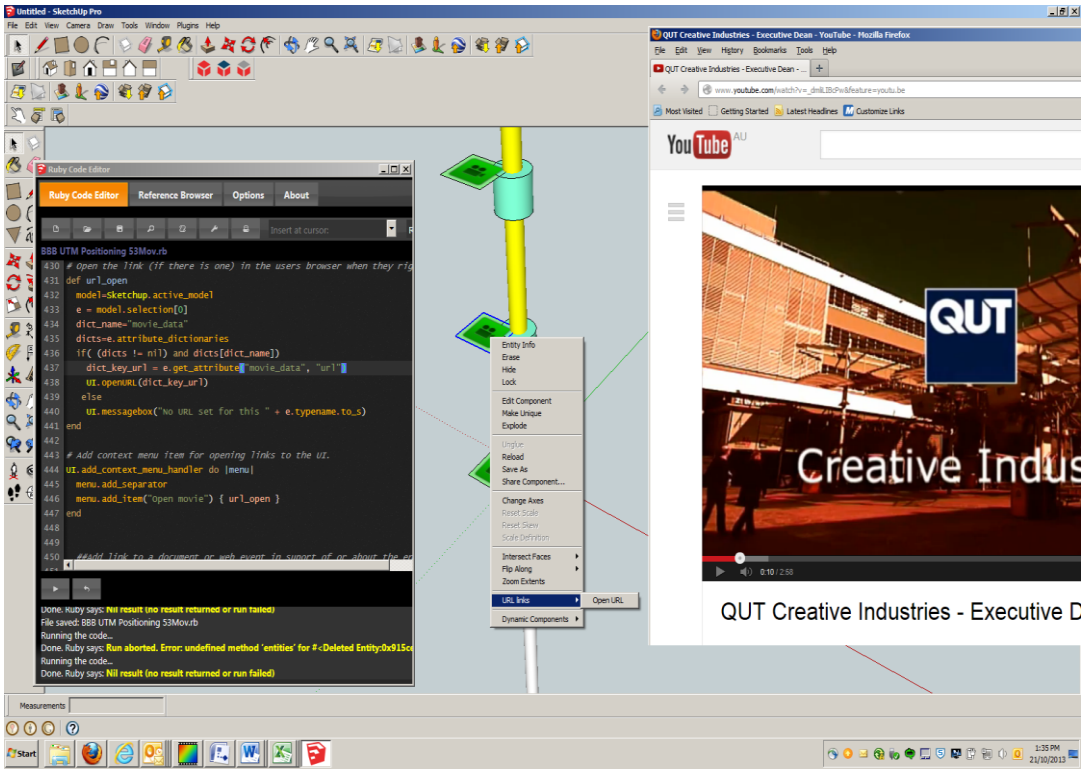

Figure 55: Model of multi events with dynamic attributes from data logger to SketchUp

6.3.4 Key Learning Outcomes and Next Steps

The list below provides the key learning outcomes from the three experiments conducted to test the modelling concepts.

- The data flow from spreadsheet to *.csv to SketchUp is successful,
- The same principal/argument of opening a URL is viable for opening any document type, and

To proceed to the next development cycle I decided on the following list of priorities:

- Logging of the DCI Research Project 2,
- Representation of a real project comparable with theory, and
- Exporting of the 3D data for the BEEDOCS representations.

6.4 CREATING THE MODEL THROUGH VARIOUS STAGES - TEST CASE 3

Table 27: Test Case 3: Proof of Concept

Test Case	Experiment	2D	3D	Comment
Test Case 3	SU 02 Exp		Yes	Use the Data Logger and representations to demonstrate project and project events

Creating version 2 of the model allowed me to finalise the method of capturing the data and processing it to form a viable visualisation.

For the next part of the experiment, I investigated how my own research project (this project) and its data were manifested in the model as a proof of concept. This proof of concept delivers a visual 3D model that represents my DCI Project 2 with dynamic attributes. These attributes had to be refined and the code had to be ordered to provide a method that can be replicated, not just in my own work, but also, in future, the work of others.

6.4.1 Collecting the Data

I have logged data using a spreadsheet during my project; simultaneously I replicated this process through direct entry of the log to the BEEDOCS application. This replication process effectively created part of the required data for the refined data logger spreadsheet, used to create the 3D and 2D models. The data collected through this process was:

Table 28: Ongoing collection of data for project

BEEDOCS Template *.csv headings	Meaning
Label	Event type
Start Time	Date that event start
End Time	Date that event ends
Link	URL to any online or offline data/site
Image	Any image associated (on- or offline)
Movie	Any Video associated (on- or offline)

In relation to the 3D model, the collection of this limited data is superficial if considered in the context of capturing evidential trails of research activity.

6.4.2 Geo-locating the Model

Geo-locating the Hybrid Publication Model plays a substantial role within my project. Coordinates indicating locality can be finite, and are used worldwide in association with rich media data. A photograph taken with most digital applied technologies allows us to see such metadata in the properties of an image. If we call up the properties of such a photo we will often see the GPS location.

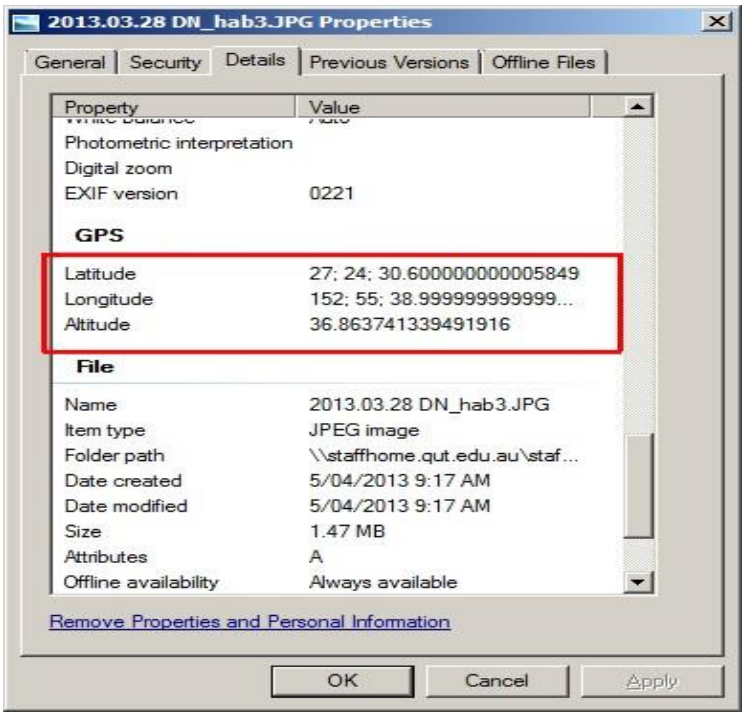

Figure 56: GPS metadata of an image

In the test case, I explained how the data could be scripted to use the Shadowinfo of the model to indicate a centre of study. In SketchUp this would appear as follows:

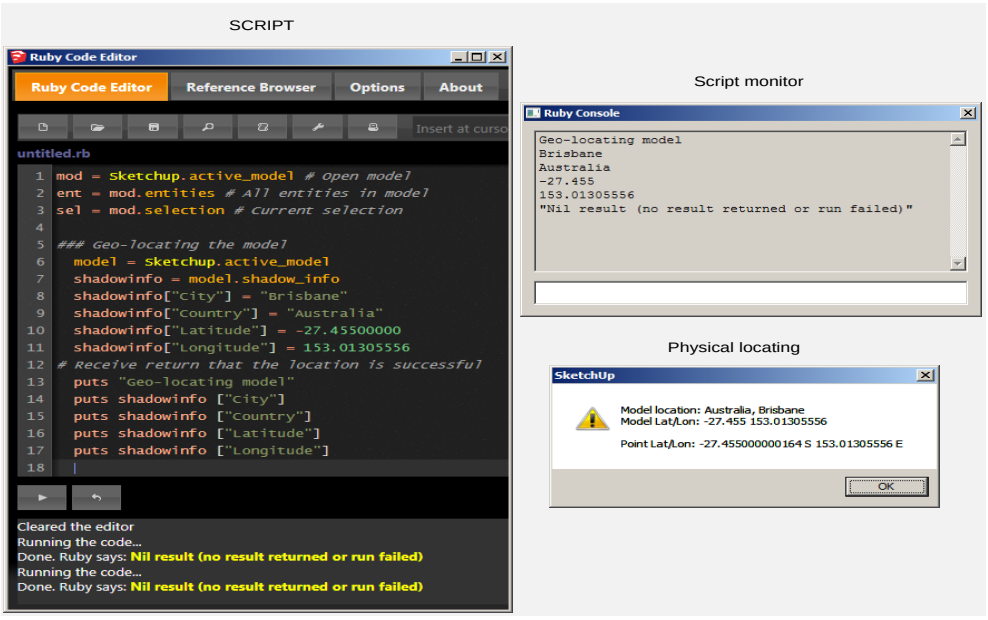

Figure 57: Standard location by Shadowinfo in SketchUp

I can use this hardcode script as a means of testing in my own project, but it cannot serve as a template for replication. This is because each project and research journey

is different and because creative practice-led research is done in different places. However, each researcher will have a chosen centre of study where their operations are based and can be claimed as a point of origin. I would, firstly, want to capture this position as the centre of study for the Hybrid Publication Model. To do this I imported the coordinates that I as the researcher specified in the data logger, a necessity that required a slight change to the setup of the data logger and the associated code. The data logger spreadsheet (big data) was updated to provide essential data at the top of the sheet as follows:

- The timescale, indicating the active year, and
- The Shadowinfo to locate the model, providing the coordinates for the centre of study.

Type of Event	Start_Date	End_Date	Lat D	Lat M	Lat S	Latitude	Long D	Long M	Long S	Longitude	Notes
Timescale	1/01/2013	1/01/2014	-27	-27	-18	-27.45500000	153	0	47	153.01305556	Daniel's Office
GeolocCity											Brisbane
GeolocCountry											Australia
GeolocLatitude			-27	-27	-18	-27.45500000					-27.45500000
GeolocLongitude							153	0	47	153.01305556	153.01305556
Project ID			-27	-27	-18	-27.45500000	153	0	47	153.01305556	Name of Project

Figure 58: Data Logger header

I used the definition argument (<if> and <elsif>) in each case, such as city, country, latitude and longitude, changing the value provided by the data logger file, which is "read" into the application through the "readData" function previously scripted in the code (see Appendix C - Code Script – *Geo-Locating the* model). In this way I have provided a flexible, personalised solution for different researchers using the model. Each would be able to enter their particular data to geo-locate the centre of their model, creating a unique point of origin associated with their particular study.

To monitor the action required, and the data processed, I used the Ruby Console, a live feedback and debugging tool. The return is noted in the Ruby Console and serves as visual confirmation of the outcome of the execution of the data script, to determine if it succeeded or failed.

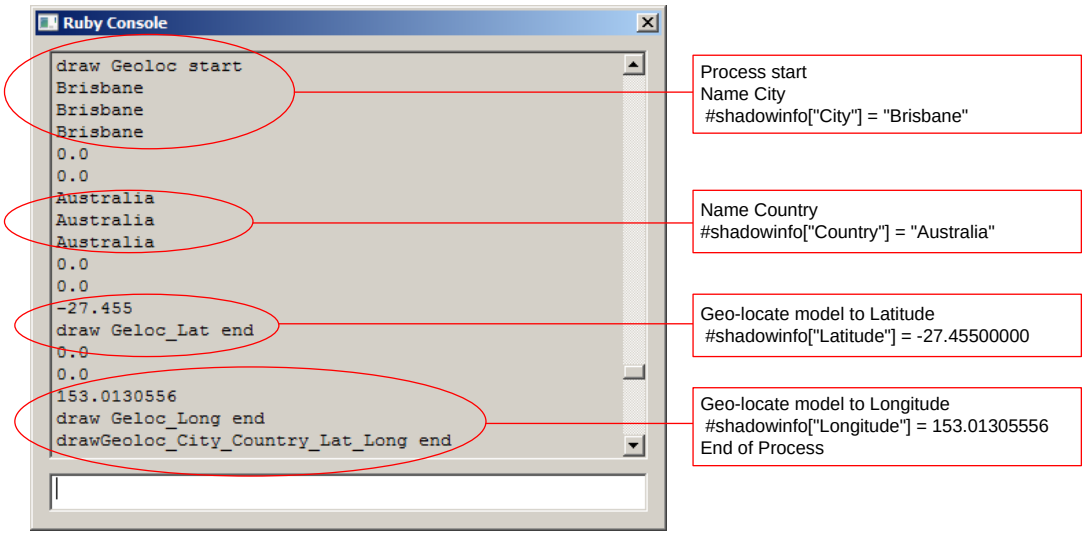

Figure 59: Return of variable geo-location by Daniel Nel script

I have now succeeded in finalising the methods necessary to import actual logged data of my DCI Project 2. In summation I reached this goal by:

- Creating a timescale that indicated the active year,
- Geo-locating the model to a centre of study,
- Providing the ability to read logged data to visualise project events,
- Creating the basic rich media components to represent the project activity, and
- Providing a method of including evidential rich media through embedded links.

6.4.3 Modelling Process Methodologies

To accurately represent my model and project activity, I reviewed the data in the general spreadsheet kept during the project activity and filled in the missing event components. This was because the original spreadsheet only featured the basic components of audio, image, video and text. Through proceeding, in this way, I can define types of events because the principal required to generate the specific representational element in the model is the use of a component variable with a unique identifier. This meant I could create a library of components representing

events, just like I did with the basic rich media components, and then add a flag component to signify the types of evidence. The process is shown in Appendix C - Code Script – *Component library scripts*. The steps actioned were:

1. Load the component to a library. (The code script retrieves small model files in representation of uniquely identified types of events);

2. Use a helper function - the component file is loaded into a definition list for the program;

3. Instruct the reading of data from the chosen *.csv file, reading each row, and separating data by column. Each column is defined as data as is, data as float (*to_f) to retain the numerical decimal value, or data as integer/whole number (*to_i);

4. Provide a method of interpreting and representing all latitude and longitude data as an array (my code includes an option that can be switched on to represent these coordinates as Universal Transverse Mercator Coordinate System (UTM) if one should wish to do so);

5. Provide amplification factors to accurately represent the values in the modelling;

6. Provide the variable statement argument <if>, <elsif> to identify a unique type of event;

7. Draw the unique event when called (creating in effect a model within the model);

8. Enhance the event with an identification flag; and

9. Provide the optional text-identifier and URL-linking functionality to enhance and make the model dynamic and rich in representation.

The above process describes the generation of one type of event. To represent my work and the future works of myself and others, I had to review my data and generate a list of resources (potential events). The list is not finite, and the development of further resources would be needed to deal with new contingencies. The following are the identifier flags I made to represent the model.

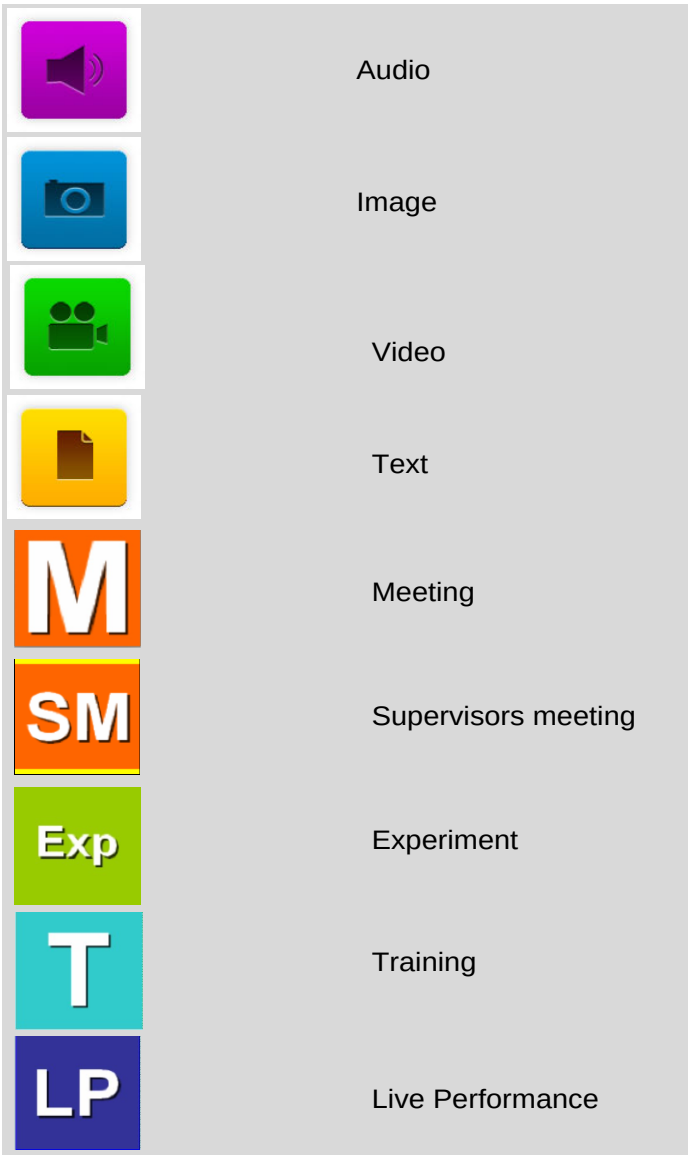

Figure 60: Examples of event flags

In the Figure 61, the base cylindrical object signifying an event in the model, which is colour-coded according to event type, indicates the duration, while the URL links are embedded to the event flag to provide instant recognition of event type. In research with NTRO it must be considered that event types can also be what in other

circumstances would classify as objects. In clarification a text event can be "I wrote a paper" or a video event "I made a movie". This places rich media elements not just as objects in representation of the event but also as the event itself.

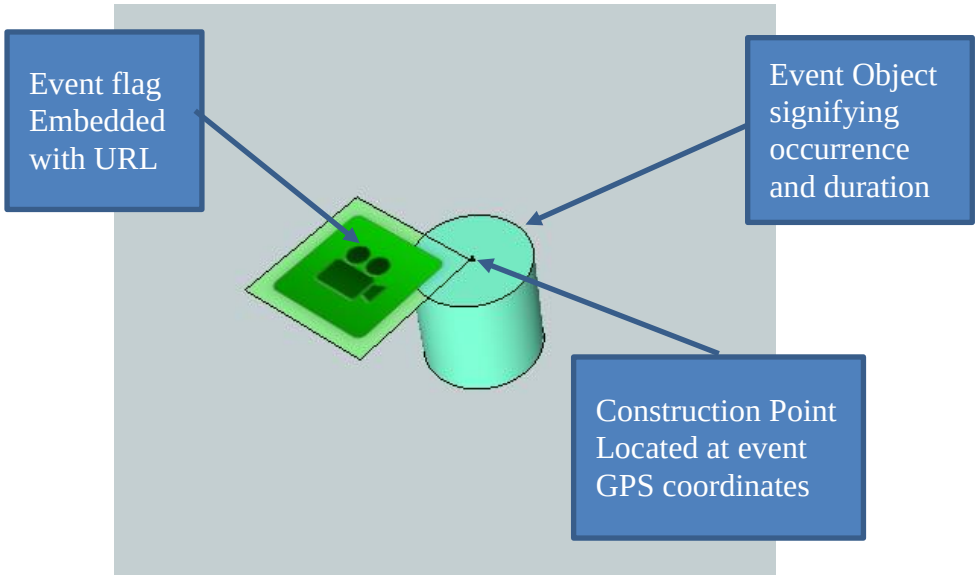

Figure 61: Event object and flag

I have achieved significant data flow automation in regards to the Evidence Logger and the Hybrid Publication Model.

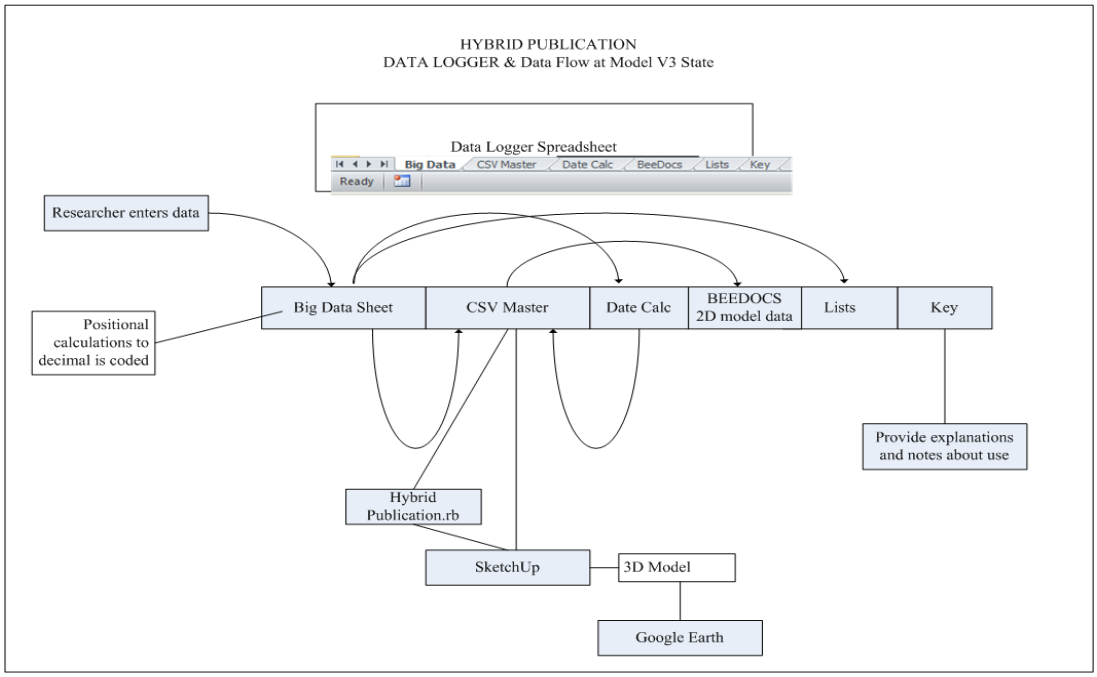

Figure 62: V3 Data Logger data flow

A full list of project data is available in Appendix C - Code Script. The model displayed as follows:

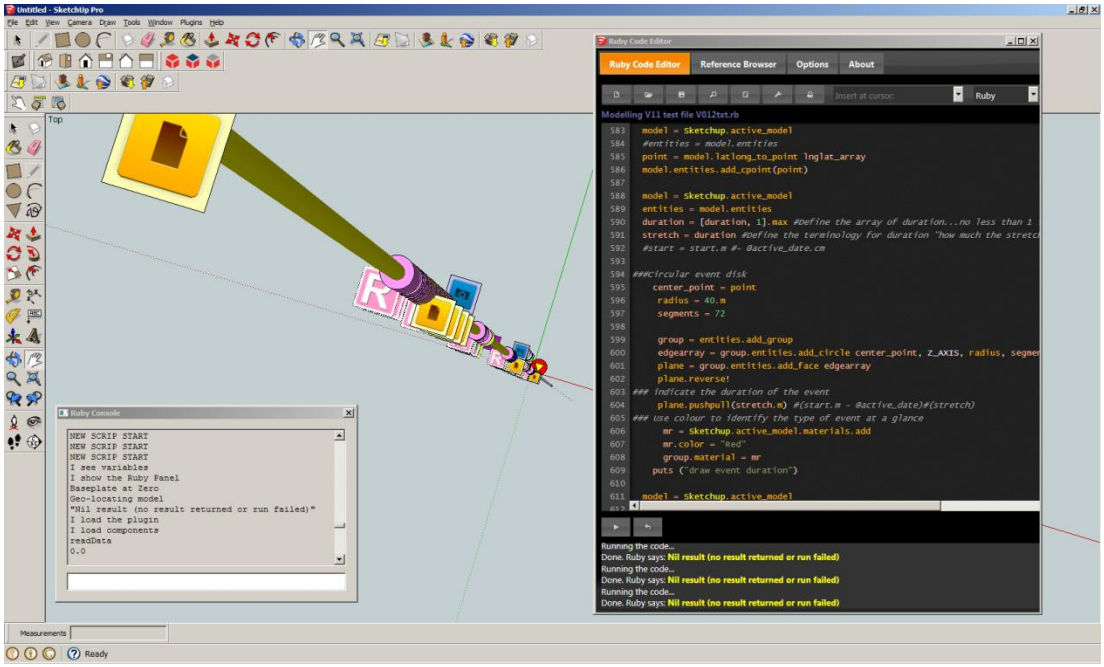

Figure 63: V3 Hybrid Publication proof of concept

At this point, the model has successfully performed all the code actions programmed to represent the data collected during the creative practice-led research journey. The proof of concept model was successful.

6.5 SUMMARY

This project (DCI Project 2) worked through three iterations of the Hybrid Publication Model to develop and present a proof of concept model. Below I address each iteration in a summative form, explaining their objectives and successes, which provided the pathway towards another action cycle of development.

6.5.1 Stage 1 - The *Machinima* Model Experiment

This model set out to represent the first depiction of an NTRO project. In this experiment I re-orientated the data presentation to better represent the sequential timeline. This allowed me to illustrate the timeframes associated with events and also to scale the central timeline. In this experiment I took initial steps towards the

identification of events, and the placement of objects, as a basic representation of attribution. This stage one modelling indicated a need to further develop the Evidence Logger and to develop a mechanism for the geo-location of the model, in a way that added a spatial dimension to event representation. In this stage of the project, I successfully experimented with exporting the model as a *.stl file for physical 3D printing.

6.5.2 Stage 2 - Theoretics Development Model Experiments

The second model developed the code script necessary for the project, and was informed by the lessons from *Machinima* around timeline representation. The second model further theorised and developed this aspect to provide a more satisfactory model that built on the original Hybrid Publication concept by representing elements highlighted in the web of facticity. Such an approach was adopted to establish that a particular pathway was available to access information for analysis and critical reflection (elements articulated in the augmented web of facticity). In such an approach these temporal and spatial dimensions were, firstly, represented as reactionary, but with the ability to, over time, chart both analytical and reflective representations of research project data. In other words, the model presented a visualisation of the source data with augmented functionality to access evidential paths.

In the process of developing the Evidence Logger and the subsequent presentation in the modelling software, I was able to formulate the pieces of data by writing write bespoke code scripts to create functionality for the application and required to generate the data streams and functionalities of the model. I scripted automated processing of this data to provide values such as the standardised numeric values for time and spatial orientation of objects within a 3D model. I also standardised the data collection construction of the Evidence Logger to facilitate use as a dataset for 3D modelling in SketchUp and 2D modelling in BEEDOCS.

The outcomes of the code script modelling experiments and the associated development process demonstrated a way of demarcating temporal data relating to

the project and events. It also allowed for geo-locating the model to a fixed location to provide for the centre of study, similarly charting variable locations to show where events associated with the project took place.

The successful completion of steps towards the proof of concept included: the representation of multiple events at a single location, the representation of multiple events at multiple locations, and the calling up of rich media evidential elements through embedded hyperlinking. Such developments meant that creative practice-led researchers could map their complete project right down to the granular exposition of a single piece of evidence. These methodologies activate one particular way for creative practice-led researchers to demonstrate and provide peer reviewers the opportunity to follow a fully documented trail of evidence. To me this step was important in developing a model that could address the question of rigour for performative, creative practice-led research.

6.5.3 Stage 3 - The Final Proof of Concept Model Experiment

The third and final stage of development started with the proof of concept to illustrate the use of the data from the Evidence Logger to represent a real research project. This proof of concept model was generated from the code-scripted functionalities developed in Stage 2, lessons learnt in that stage, and the refinements made to the proof of concept iteration. For ease of access, I used the data collected, over time, from my own DCI research project. The resulting model showed immediate, recognisable patterns of activity that I classified as periods of passive and active research. First there was the background reading and the location of contextual information necessary to inform the goal of the particular development (passive). This process was then followed by an experiment and concluded by an evidential element that articulated the model's capability to demonstrate the presentation of an evidential trail (active).

The evidential trail is shown in the representation of research activity (the model) as events, and objects associated with such events. Once a model or period in the model is completed, instant cognitive interpretation plays a role. In a more pragmatic and

succinct explanation, this means that when looking at the model after running the code script, one immediately recognises objects that represent events. Often the appearance of these objects, which are colour-coded and unique to categories of work, enables one to interpret repeating patterns. In this case, I see a research period, followed by experimentation and then an evidential outcome. If one looks at the model with a central timescale and follows significant events, the approach resembles that of air accident investigations that use Flight Data Management (FDM) systems in modelling and reconstructing events over a period of time (Boccalatte et al. 2005). Often, such representative visualisations provide instant recognition and interpretations from just viewing the model. Individual events along the timeline can then be further explored.

Locality in space for reactive, forensic evidential investigations such as those mentioned above provides direct representations of an event's point of origin. I show in the case of my research model that this contributes to the notion of provenance. In my model, all events are geo-located to their place of occurrence. This place of occurrence is defined by the captured GPS location and date. By doing this I demonstrate that the timeline, and events along the timeline, are mapped to a three-point provenience[14]. This anchoring of events in 3D allows the use of time and spatial plotting to provide reactive indicators towards the establishing of provenance for CI performative research using NTRO.

In practice, the model demonstrates the ability to access evidential elements, through the more advanced work done in the development of the forensic timeline functionality. This functionality is established by providing access to evidential rich media elements by a hyperlink function embedded in the model object representing an event. This functionality provides the further exploration of evidential trails that can unlock the more advanced levels of inquiry, namely the analytical and the reflective.

[14] One locating point for date (time) and two locating points for place (coordinates) together create a single intersecting point of provenience.

Part 7: CRITICAL REFLECTIONS

In conclusion and as a reflective view this chapter in the exegesis provides critical reflections in reaction and analysis of the development of the emerging, and now tested, Hybrid Publication Model. For me, this chapter then is the critical and longer term reflective soundboard of DCI Projects 1 and 2, and at the same time this chapter becomes the forbearer to continue with post-doctoral work. Such work include but is not limited to the articulation and facilitating the ongoing development of ways to progressively document, archive and curate non-traditional research data. In doing so, I position this study series as the precursor to the next thematic iteration to progress this work and knowledge further.

This study proposes a model of practice that creative practice researchers producing NTRO can follow. Furthermore this model can be used to legitimate this domain of academic research (performative research with NTRO) and can help to manage, report and articulate research conducted in the field of creative practice; positively influence the peer review protocols that apply in such a domain; and impact the approach of creative practice-led researchers employing organisation, the academic fields that involve creative non-traditional practice, and those allied fields that, previously, have concentrated on traditional research.

The sorts of approaches that this research facilitates are necessary to the development of new approaches that can cater to the sort of research activities that current HDR students need to pursue. These factors are supported through “map-linked” (mapping the when and where and linking to evidence) models that articulate journeys of performative research with NTRO, in a way that can contribute to existing knowledge, or produce new knowledge. This knowledge is produced through unlocking different levels of inquiry and documenting, publishing and reviewing the research outcomes through means which demonstrate practice-led research in a new way.

In the creative practice research arena, media elements are often used to document, represent and present creative practice. The data derived from such research then can be interpreted as

non-traditional research data and output (NTRO) and becomes the decoder and main communicator of such work. To establish provenance from such data means that the recorded data representing the event and the recorded data of occurrence of the event itself, needs to either carry appropriate attributions, or act as the attributions for the project. For example, the recorded date and place of an event becomes the attribution of the research journey. Evidential media elements become attributions of the events of the research journey depicted in the model. Each media element used as attribution also carries metadata about the media element. Two parts of this metadata, often recorded, are the date stamp and the coordinates where such a media element originates, providing deeper levels of data related to provenance.

To prove this point, I refer back to the web of facticity and the means through which I have framed provenance for use as a key concept in establishing the veracity of Creative Industries research[15]. My approach identifies the attribution of media elements as evidential parts but also captures event-related data (who did what, where, when, why and how?). I can systematically capture the history of performative and creative practice-led research and use such data to construct temporal or spatial representations (models/visualisation) attributed with evidential elements. These pieces of data can therefore become building blocks in the construction of the model and the evidential trail. The trail can be linear sequential, or evidential, providing the opportunity to follow or investigate journeys of creative practice-led research. This is the "forensic" creative evidential trail. Academically such acts can be described as contextual, contributory, evidential, original, referential, proof of origin and ownership. An accepted way of producing scholarly writing is to use the process Point → Evidence → Relevance. In this study I have demonstrated that making performative data the publication of NTRO in reality means that the conceptual understanding of how we "write" this data, to express a similar process as in pure text writing, is central to the thrust of non-traditional data representation. To clarify this I provide the following table of interpretation:

Table 29: The relationship between writing and performative research

[15] I frame the synthesis of provenance for the Creative Industries as follows: "the capturing of origin, attribution, source and background to all artefacts and events that form part of the output of the research".

Traditional Text	Mapping Performative Research
Point	An event (creative practice or documentative)
Evidence	Captured documentative records of NTRO
Relevance	The relationship between the data recorded and the events of the creative practice-led research/creative practice journey, including contributions to knowledge and impact

In the context of my research conducted for this DCI series, I have displayed levels of inquiry that are equal to those that I have sought to clarify and demonstrate. Arguably, as a creative practice-led researcher I have made the point of documenting events, showing evidential trails and finding the relevance in the eventual outcome that contributes to new knowledge and impact. The levels were, throughout, identified as reactive, analytical and reflective, all of which I can attribute to critical inquiry and investigative action. All these factors are now displayed and accessible through the Hybrid Publication Model.

7.1 VALUABLE CONTRIBUTION FOR THE RESEARCHER

My project's demonstration of the Hybrid Publication Model underlines the value in bringing data together with research activities that previously were located "everywhere and nowhere"[16]. For the creative practice researcher, methodical capturing of data through the life of a practice-led/based research project is essential to establish evidential trails. A researcher can take advantage of techniques such as temporal and geo-spatial tagging of all rich media elements. Such action allows for more flexible research processes that can create metadata to capture the evidential trail through which the augmented web of facticity can be demonstrated.

[16] Ad-hoc data management, framed as "everywhere and nowhere" in my first DCI Research Project, is a risk and an identified shortcoming of the research practice by researchers who submitted projects for ERA 2012 in CIF.

7.2 RENEWED INSTITUTIONAL APPROACHES

This research recommends that in order to cater to the changing social and academic environment, academic institutions should focus a great deal more attention on the function of digital curation, and, in particular, of the artefacts and evidence of creative practice research. Such a focus would guard against the loss of digital material and save the time of people who, otherwise, might have to undergo a protracted search for it. Such institutional approaches should adapt emerging mobile and digital approaches to reflect the robustness of scholarly work.

To prevent the loss of valuable digital material institutions should provide system architecture embedded with standardised policies and protocols that support creative NTRO. The approach should work from the bottom up to take into account the specific practices of creative researchers so that the documentation that they produce can be stored safely in a "place" that is sufficiently well resourced to store creative big data.

7.3 HYBRID PUBLICATION AND QUALITY ASSURANCE SYSTEMS

The international expectations from quality assurance systems that deal with creative practice research with mainly NTRO are low. As a result, it is often difficult to find and to represent the research outcomes- that such creative artefacts contain. For example: in Australia, Appendix 2 of the ERA 2012 Peer Review Handbook calls for a statement no longer than 2000 characters (around 400 words) to explain the research merit of NTRO (ARC 2012). In the United Kingdom, artefacts other than journal articles or conference proceedings are still expected to be provided in an electronic format where one exists. Otherwise, reviewers must access the artefact, in its physical form, at the Research Excellence Framework (REF) warehouse.

The time-based, attributed data visualisation, the making of a representational model with dynamic interactive parts, that the Hybrid Publication Model encompasses, can transform this approach by capturing research data through the life of the research, an approach that could transform research quality control systems internationally. In addition to tracking the individual research journey, the research can allow for a broader approach that captures

dynamic and ongoing research. To achieve this goal, the evidentiary logger (the instrument for capturing and collecting the ongoing basic data) needs the capacity to trace the antecedents of a particular piece of research and the relationships between previous research outcomes that produced a refinement or recanting. For the future, the evidentiary logger needs to project forward to various works in progress that examine similar objects and/or events in the same or different ways and that relate new understandings to each other in the same or different ways. An example is where the current Sonic Arts Engineering research of academics at Victoria University in Wellington, New Zealand (Wellington 2012)contributes to the overall research by Professor Ajay Kapur relating to interaction, intelligence and design (Murphy et al. 2015). Here the evidential logger can predict merge points and set goals as Key Performance Indicators in the future while documenting and tracking the work as it progress.

Such a model allows for movement beyond the reactive historic stage that can, at the analytical and reflective levels of inquiry, can be compared to the reactive level of inquiry. Bowman argued for such an understanding when addressing the levels of inquiry that can occupy the same space and time, stating about journalists: "In this way, they could provide more than the superficial coverage that might emerge from an initial attempt to cover a perhaps unpredictable and surprising event or issue" (Bowman 2003, P.225). Such an approach when applied to critical inquiry within the realm of performative research, will deliver further dimensions for analysis and reflective practice. This proposition is solidified in the diagram below. In isolated viewpoints and interpretation window A represents the past, window B represents the present and window C represents the future.

A	B	C
2013	**2014**	**2015**
What happened? Who did it? When did it happen? Where did it happen?	What is happening? Who is doing it? When is it happening? Where is it happening?	What is going to happen? Who will do it? When will it happen? Where will it happen? Who will it benefit?

Figure 64: Positioning in time for dialog that informs the levels of inquiry

However, this process also allows for the consideration of A, B and C as a single entity. It allows for the telling of the linear sequential story as it unfolds in a way that also allows for attention to its history and status and that permits the forming of future predictions. Such factors are now tied to the levels of inquiry (reactive, analytical and reflective) through time interpretation (historic, current and consequential into the future) and are also represented spatially, through a definite identifying quantitative value (coordinates). These factors, together, provide a set of qualitative data that, when viewed in a dynamic way, becomes performative. This summation has uncovered the practical steps that are required to achieve rigour sufficient to meet provenance.

7.4 HYBRID PUBLICATIONS AND PEER REVIEWING

The model does not set the standard for the research and discipline, but enables the reviewer to engage with the inquiry and evidential trails of the researcher. The reviewer is then able to make decisions about the meeting of benchmarks or the setting of such standards.

Peer reviewing creative practice research with mainly NTRO, as witnessed in the ERA rounds of 2010 and 2012, is at best a cumbersome and arduous task. In the absence of substantial advice from the ARC there are no standardised requirements that can be used to benchmark the peer review of creative practice research as conforming to a world standard. In the first place, the capturing of the temporal and spatial antecedents of this research provides provenance. Secondly, the provision of the hyperlinked pathway to the forensic evidential trails can illuminate contextual and research-evidential artefacts. Currently, peer reviewing is conducted in a way that cannot allow for such close scrutiny of research artefacts and the environments and contexts from which they emerge. In my model the research emerges in the form of the levels of inquiry and the establishment of provenance.

This is possible because the model allows the reviewer to physically view the project and associated events, and call up digital evidence that can more adequately portray relationships between various pieces of data that, in turn, more adequately portray its richness. To summarise, the model is a different way of "writing and reading", it is visually engaging, and it provides a sense of anticipation for discovery and exploration. Most importantly, however,

this method of using a hyperlinked model could provide a simple pathway that only requires reviewers to have access to the World Wide Web, a cost- and time-effective approach to reviewing.

7.5 REACHING INTO TRADITIONAL RESEARCH APPROACHES

The method of documenting with media elements is already entering the world of traditional research. But the paradigm of performative research has opened the door to combine the traditional realms of qualitative and quantitative research with performative research, creating research data outputs with mixed orientation.

7.6 ADVANCES FOR THE FIELD OF CREATIVE PRACTICE RESEARCH

DCI Project 2 has enabled the development of the Hybrid Publication Model to the level of a proof of concept with a sound theoretical grounding. Although the idea of the Hybrid Publication was unlocked by my awareness of the nature of the performative research paradigm, it took the web of facticity and the levels of inquiry, crafted in the field of journalism, to provide the theoretical basis for the augmented web of facticity that I have established as a benchmark for research in the Creative Industries. Such an understanding indicates that different disciplines within the Creative Industries field can profitably join together to create new knowledge and approaches to creative practice-led research.

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List of Abbreviations

2D	Two-dimensional
3D	Three-dimensional
CI	Creative Industries
CIDI	Creative Industries Digital Infrastructure Development Project
CIF	Creative Industries Faculty
CIFTS	Creative Industries Faculty Technical Services
DAM	Digital Asset Management
DCI	Doctor of Creative Industries
EGS	Enhanced Geothermal Systems
ERA	Excellence in Research for Australia
NTRO	Non-Traditional Research Outputs
POC	Proof of Concept
QUT	Queensland University of Technology
REF	Research Excellence Framework (UK quality control of research)

List of Terminology

Applied Technologies	Handheld and desktop technical devices used by Creative Industries practitioners in the creation or manipulation of their work. Most commonly a camera, recorder or editing device.
Creative Rich Media	Rich media created with the intent of being creative or entertaining.
Documentative Rich Media	Rich media content created with the intent to record evidence of existence, happening or appearance. Demonstrative, not the original but a likeness or existence of the artefact.
Emic	Positioning of the researcher: the insider viewpoint.
ERA Package	A digital file package representing a non-traditional output of a researcher's project made for a submission in an ERA round.
Etic	Positioning of the researcher: the outsider viewpoint.
Hybrid Publication	The term *Hybrid* demonstrates a literal understanding where more than one, or a mixture of different aspects or components combined, can form something new. For this project it is used as a model with research evidential trails assembled over a period of time for a research project, and distilled into a representation of choice.
Performative Research	The paradigm claimed by Professor Bradley Haseman (Haseman 2006).
Performative Research Forensic Timeline	A timeline used in the context of creative practice-led research. Adapted to augment the academic thesis with mainly non-traditional research outputs where nonlinear investigation of evidential elements in support of such a research journey is provided to satisfy peer review and levels of inquiry over time.

Professional (person)	Someone with knowledge and ability receiving payment for the use thereof. Usually operates at a globally-recognised standard.
Publieksgeschiedenis	Public history (Dutch to English).
Rich Media Assets	Digital media files attributed with meaning and method for use, search, discovery and rights management.
Scenography	Representation of an object in perspective. Literally means scene painting for theatre. Derives from the Greek to Latin term *skēnographia*: a drawing in perspective.
Tjidlynen	Timelines (Dutch to English).
Web of Facticity	Commonly used to describe the requirement or application of six elements of reactive reporting: Who, What, When, Where, Why and How.
Evidential Forensic Timeline	This timeline is the documentative record (evidential trail) that often presents as rich media elements, and is used most commonly to articulate the work of the creative practice-led and performative researcher.

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Appendix A – Timeline Suitability Scores

Timeline Solution Fit for Purpose Scores

BEEDOCS http://www.beedocs.com/
Dipity http://www.dipity.com/
Tiki-Toki http://www.tiki-toki.com/
Timeglider http://timeglider.com/
Timeline JS http://timeline.knightlab.com/

DIGITAL TIMELINES - COMPARISON CHART
Fien Danniau - Institute for Public History (Ghent University) - www.ipg.ugent.be - June 2012
Daniel Nel - Creative Industries Faculty, Queensland University of Technology - www.qut.edu.au - May 2013

Name of timeline solution	**Beedocs**	**Dipity**	**Tiki Toki**	**Timeglider**	**Timeline JS**
Danniau Score	**32**	**28**	**43**	**32**	**28**
How easy is it to find the timeline?	5	5	5	5	5
Can I download it and install without problems?	5	0	0	0	0
Has the timeline been established and survived at least 12 months online?	5	5	5	5	5
Can the timeline representation import data from a *.csv file?	5	0	0	0	0
Can the same data source be used for this 2D representation as well as the 3D representation of Hybrid Publication?	5	0	0	0	0
Can I represent the work of a researcher in full, short and condensed form?	5	0	0	0	0
Can I add media to the events on the timeline?	5	5	5	5	5
Can the timeline accommodate all the file types previously associated with ERA?	5	0	0	0	0
Can the timeline be used online?	5	5	5	5	5
Can the timeline be used offline?	5	0	0	0	0
What is the “look and feel?” (a subjective score)	5	5	5	5	5
	87	**53**	**68**	**57**	**53**

Danniau Timeline Comparison Chart (2012)

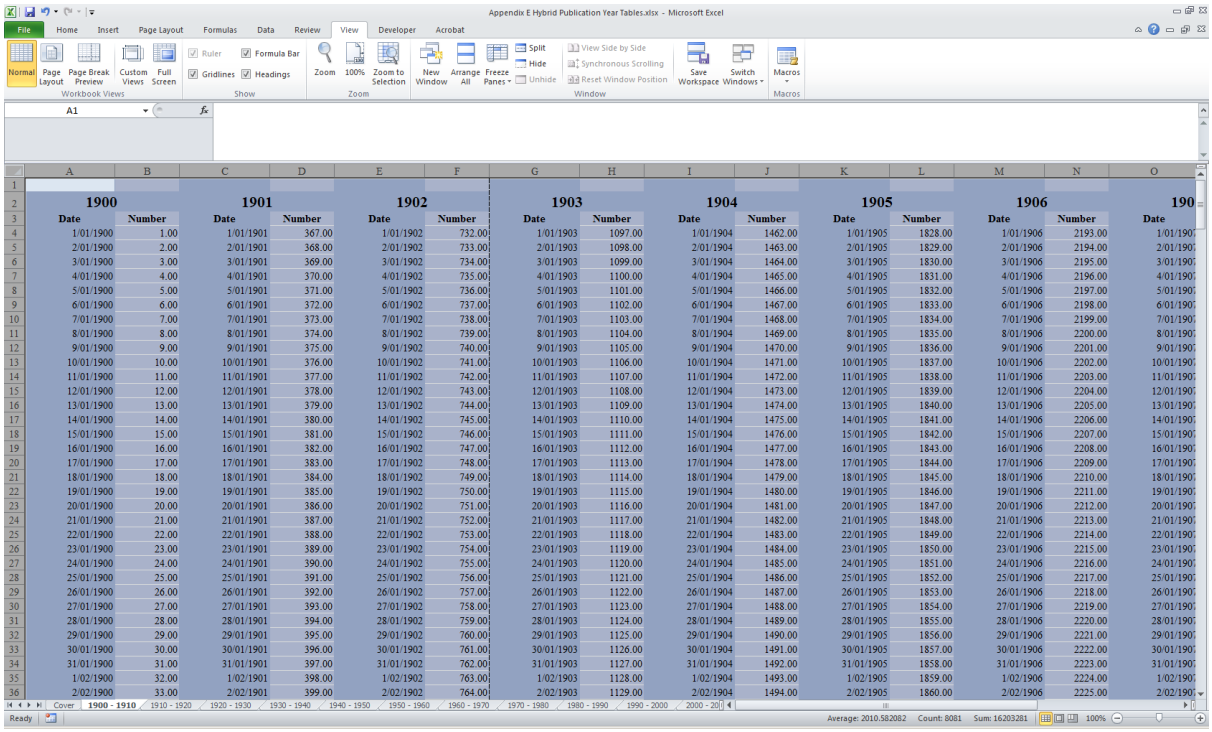
DIGITAL TIMELINES - COMPARISON CHART

	BEEDOCS	DIPITY	MEMOLANE	SIMILE	TIKI TOKI	TIMEGLIDER	TIMELINE JS	TIMERIME	TIMETOAST	XTIMELINE
										
url	www.beedocs.com	www.dipity.com	memolane.com	www.simile-widgets.org	www.tiki-toki.com	timeglider.com	timeline.verite.co	www.timerime.com	www.timetoast.com	www.xtimeline.com
costs	$20 / $65	$0-100/month	free	open source	$0-20/month	$0-75	open source	€0-7500	free	free
CONTENT				* code			* code			
Multi-lingual	v			v	v		v	v		v
html text				v	v		v			
BC	v			v	v	v				v
image	v	v	v	v	v	v	v	v	v	v
video	v	v	v	v	v		v	v		
link	v	v		v	v	v	v	v		v
themes				v	v	v				
tags				v		v				
DESIGN										
change colours	v				v	v				
change background	v	v			v					
change position events	v				v			v		
INPUT										
import CSV				v	v	v	v	v		
import RSS	v	v			v					
import social media		v	v				v			
media via remote url		v		v	v	v	v	v		v
cooperate		v		v	v	v	v			v
USE										
zoom	v	v		v		v	v	v	v	
search		v	v			v				
filter				v		v				
full screen	v	v			v	v				
SHARE										
online publication		v	v		v				v	v
embed	v	v	v	v	v	v	v	v	v	v
export to CSV				v	v	v	v			
print	v				v	v		v		v
comment		v	v						v	
Content complexity	3	2	0	4	3	3	2	2	1	1
Visual design	4	2	2	1	4	3	3	1	1	1
Media use	2	3	1	2	4	1	2	4	1	1
Input friendly	2	2	3	3	4	3	3	3	1	1
Personalization	4	1	0	2	4	2	2	0	0	0
Usability	2	1	2	4	4	3	2	3	1	1
2.0	0	3	4	0	1	1	3	1	2	2

Fien Danniau - Institute for Public History (Ghent University) - www.ipg.ugent.be - june 2012

Appendix B – Sample of Numeric Tables

Sample of Date Numeric Tables for Hybrid Publication Calculations



1900		1901		1902		1903		1904		1905		1906		190
Date	Number	Date	Number	Date	Number	Date	Number	Date	Number	Date	Number	Date	Number	Date
1/01/1900	1.00	1/01/1901	367.00	1/01/1902	732.00	1/01/1903	1097.00	1/01/1904	1462.00	1/01/1905	1828.00	1/01/1906	2193.00	1/01/190
2/01/1900	2.00	2/01/1901	368.00	2/01/1902	733.00	2/01/1903	1098.00	2/01/1904	1463.00	2/01/1905	1829.00	2/01/1906	2194.00	2/01/190
3/01/1900	3.00	3/01/1901	369.00	3/01/1902	734.00	3/01/1903	1099.00	3/01/1904	1464.00	3/01/1905	1830.00	3/01/1906	2195.00	3/01/190
4/01/1900	4.00	4/01/1901	370.00	4/01/1902	735.00	4/01/1903	1100.00	4/01/1904	1465.00	4/01/1905	1831.00	4/01/1906	2196.00	4/01/190
5/01/1900	5.00	5/01/1901	371.00	5/01/1902	736.00	5/01/1903	1101.00	5/01/1904	1466.00	5/01/1905	1832.00	5/01/1906	2197.00	5/01/190
6/01/1900	6.00	6/01/1901	372.00	6/01/1902	737.00	6/01/1903	1102.00	6/01/1904	1467.00	6/01/1905	1833.00	6/01/1906	2198.00	6/01/190
7/01/1900	7.00	7/01/1901	373.00	7/01/1902	738.00	7/01/1903	1103.00	7/01/1904	1468.00	7/01/1905	1834.00	7/01/1906	2199.00	7/01/190
8/01/1900	8.00	8/01/1901	374.00	8/01/1902	739.00	8/01/1903	1104.00	8/01/1904	1469.00	8/01/1905	1835.00	8/01/1906	2200.00	8/01/190
9/01/1900	9.00	9/01/1901	375.00	9/01/1902	740.00	9/01/1903	1105.00	9/01/1904	1470.00	9/01/1905	1836.00	9/01/1906	2201.00	9/01/190
10/01/1900	10.00	10/01/1901	376.00	10/01/1902	741.00	10/01/1903	1106.00	10/01/1904	1471.00	10/01/1905	1837.00	10/01/1906	2202.00	10/01/190
11/01/1900	11.00	11/01/1901	377.00	11/01/1902	742.00	11/01/1903	1107.00	11/01/1904	1472.00	11/01/1905	1838.00	11/01/1906	2203.00	11/01/190
12/01/1900	12.00	12/01/1901	378.00	12/01/1902	743.00	12/01/1903	1108.00	12/01/1904	1473.00	12/01/1905	1839.00	12/01/1906	2204.00	12/01/190
13/01/1900	13.00	13/01/1901	379.00	13/01/1902	744.00	13/01/1903	1109.00	13/01/1904	1474.00	13/01/1905	1840.00	13/01/1906	2205.00	13/01/190
14/01/1900	14.00	14/01/1901	380.00	14/01/1902	745.00	14/01/1903	1110.00	14/01/1904	1475.00	14/01/1905	1841.00	14/01/1906	2206.00	14/01/190
15/01/1900	15.00	15/01/1901	381.00	15/01/1902	746.00	15/01/1903	1111.00	15/01/1904	1476.00	15/01/1905	1842.00	15/01/1906	2207.00	15/01/190
16/01/1900	16.00	16/01/1901	382.00	16/01/1902	747.00	16/01/1903	1112.00	16/01/1904	1477.00	16/01/1905	1843.00	16/01/1906	2208.00	16/01/190
17/01/1900	17.00	17/01/1901	383.00	17/01/1902	748.00	17/01/1903	1113.00	17/01/1904	1478.00	17/01/1905	1844.00	17/01/1906	2209.00	17/01/190
18/01/1900	18.00	18/01/1901	384.00	18/01/1902	749.00	18/01/1903	1114.00	18/01/1904	1479.00	18/01/1905	1845.00	18/01/1906	2210.00	18/01/190
19/01/1900	19.00	19/01/1901	385.00	19/01/1902	750.00	19/01/1903	1115.00	19/01/1904	1480.00	19/01/1905	1846.00	19/01/1906	2211.00	19/01/190
20/01/1900	20.00	20/01/1901	386.00	20/01/1902	751.00	20/01/1903	1116.00	20/01/1904	1481.00	20/01/1905	1847.00	20/01/1906	2212.00	20/01/190
21/01/1900	21.00	21/01/1901	387.00	21/01/1902	752.00	21/01/1903	1117.00	21/01/1904	1482.00	21/01/1905	1848.00	21/01/1906	2213.00	21/01/190
22/01/1900	22.00	22/01/1901	388.00	22/01/1902	753.00	22/01/1903	1118.00	22/01/1904	1483.00	22/01/1905	1849.00	22/01/1906	2214.00	22/01/190
23/01/1900	23.00	23/01/1901	389.00	23/01/1902	754.00	23/01/1903	1119.00	23/01/1904	1484.00	23/01/1905	1850.00	23/01/1906	2215.00	23/01/190
24/01/1900	24.00	24/01/1901	390.00	24/01/1902	755.00	24/01/1903	1120.00	24/01/1904	1485.00	24/01/1905	1851.00	24/01/1906	2216.00	24/01/190
25/01/1900	25.00	25/01/1901	391.00	25/01/1902	756.00	25/01/1903	1121.00	25/01/1904	1486.00	25/01/1905	1852.00	25/01/1906	2217.00	25/01/190
26/01/1900	26.00	26/01/1901	392.00	26/01/1902	757.00	26/01/1903	1122.00	26/01/1904	1487.00	26/01/1905	1853.00	26/01/1906	2218.00	26/01/190
27/01/1900	27.00	27/01/1901	393.00	27/01/1902	758.00	27/01/1903	1123.00	27/01/1904	1488.00	27/01/1905	1854.00	27/01/1906	2219.00	27/01/190
28/01/1900	28.00	28/01/1901	394.00	28/01/1902	759.00	28/01/1903	1124.00	28/01/1904	1489.00	28/01/1905	1855.00	28/01/1906	2220.00	28/01/190
29/01/1900	29.00	29/01/1901	395.00	29/01/1902	760.00	29/01/1903	1125.00	29/01/1904	1490.00	29/01/1905	1856.00	29/01/1906	2221.00	29/01/190
30/01/1900	30.00	30/01/1901	396.00	30/01/1902	761.00	30/01/1903	1126.00	30/01/1904	1491.00	30/01/1905	1857.00	30/01/1906	2222.00	30/01/190
31/01/1900	31.00	31/01/1901	397.00	31/01/1902	762.00	31/01/1903	1127.00	31/01/1904	1492.00	31/01/1905	1858.00	31/01/1906	2223.00	31/01/190
1/02/1900	32.00	1/02/1901	398.00	1/02/1902	763.00	1/02/1903	1128.00	1/02/1904	1493.00	1/02/1905	1859.00	1/02/1906	2224.00	1/02/190
2/02/1900	33.00	2/02/1901	399.00	2/02/1902	764.00	2/02/1903	1129.00	2/02/1904	1494.00	2/02/1905	1860.00	2/02/1906	2225.00	2/02/190

Screenshot: Date Numeric Tables for Hybrid Publication Calculations

A full set of Date Numeric Tables were developed from 1900 to 2030.

Appendix C – Code Scripts

- **Header of the script**

```
#This is a Ruby script for DCI Project

#Performative Digital Asset Management Part II

#This script was written by Daniel Nel with the help of others acknowledged at the end of this file

#Parts of this script is adopted from free available API and

#with permission of the authors - Didier Bur and Jared Donovan

    # Means: NOTE for what is to follow or about the preceding

    ### Means: the code is switched off for some reason by Daniel Nel

###>>>>----------fin----------<<<<<###

### Acknowledgement 1

### Add URL to entity(event) Copyright 2004, Didier Bur Permission to use, copy, modify, and distribute this software for any purpose and without fee is hereby granted, provided that the above copyright notice appear in all copies.

#Daniel Nel with the help of Jared Donovan modified this script in 2013 for DCI project.

### Acknowledgement 2

### Basic Code & script development provided by Jared Donovan to create the foundations of statements and definitions

### Acknowledgement 3

### Sketchucation forums for Ruby snippets http://sketchucation.com/
```

- **3D Construction Point Script**

```
model = Sketchup.active_model
```

```
entities = model.active_entities

point1 = Geom::Point3d.new (10,0,0)

constpoint = entities.add_cpoint point1

#Returns 10,0,0

Position = constpoint.position
```

3D Construction Point Script

- **Geo-Locating the Model Script**

```
# Geo-locating the model

 model = Sketchup.active_model

 shadowinfo = model.shadow_info

 shadowinfo["City"] = "Brisbane"

 shadowinfo["Country"] = "Australia"

 shadowinfo["Latitude"] = -27.45500000

 shadowinfo["Longitude"] = 153.01305556

puts "Geo-locating model"
```

Geo-locating Script

- **Code Strings to access data**

Provide a location for the data to be read from:

```
@data_filename = "C:/Users/neld/Documents/Coding/Sketchup/data.csv"
```

Data File Path Script

- **Provide a positional variable that can be read as an array**

```
@position = ["latitude", "longitude"]
```

Position Array Script

- **Instruct the application to read data from the file**

Type of data = Variable = column of the data sheet

```
# Read the data from the file.

def readData

 puts("readData")

 file = File.new(@data_filename, 'r')



 file.each_line("\n") do |row|

  #puts('readLine')

   columns = row.split(",")
```

Read from File Script

- **Identify which columns of the data logger will hold the positional data**

and that it is read as a float (*.to_f) which keeps the decimal value.

```
   lat = columns[3].to_f

   long = columns[4].to_f
```

Nominate Data Type Location

- **Code Strings for frequently used locations – hardcoding a position**

QUT J-Block Workshops – Gardens Point Campus Brisbane

```
Draw a point in Brisbane Australia (-27.476595S, 153.027283E)

#- The J-Block KG position

 lnglat_array = [153.027283, -27.476595]

 model = Sketchup.active_model

 cpt_p1 = model.latlong_to_point lnglat_array

 model.entities.add_cpoint(cpt_p1)
```

```
### J-Block Locator - A "Red" cylindrical marker on the position
    center_point = cpt_p1
    radius = 100.m
    segments = 72

     #center_point = cpt_p1
     group = entities.add_group
     edgearray = group.entities.add_circle center_point, Z_AXIS, radius, segments
     plane = group.entities.add_face edgearray
     plane.pushpull(-20.m)

     mr = Sketchup.active_model.materials.add
     mr.color = "Red"
     group.material = mr
     puts ("Direct draw .... J-Block")
```

Hardcode J-Block Ref Script

- **QUT Gasworks Studios – Newstead, Brisbane**

```
# Draw a point in Brisbane Australia (-27.476595S, 153.027283E)
#- The Gasworks Studios position
 lnglat_array = [153.0433333, -27.45194444]
 model = Sketchup.active_model
 cpt_p2 = model.latlong_to_point lnglat_array
 model.entities.add_cpoint(cpt_p2)
```

```
### Gasworks Studios Locator - A "Red" cylindrical marker on the position
    center_point = cpt_p2
    radius = 100.m
    segments = 72

     #center_point = cpt_p2
     group = entities.add_group
     edgearray = group.entities.add_circle center_point, Z_AXIS, radius, segments
     plane = group.entities.add_face edgearray
     plane.pushpull(-20.m)

     mr = Sketchup.active_model.materials.add
     mr.color = "Red"
     group.material = mr
     puts ("Direct draw .... QUT Gasworks Studios")
```

Hardcode Gasworks Ref Script

- **Defining a year in code**

```
one_year = 3650.m #1 day = 10000mm (or 10m), thus 365 days = 365 x 10,000mm = 3650000mm (or 3650m)
```

Metric Year Definition Script

- **Active Year extrusion script**

```
edgearray = group.entities.add_circle center_point, Z_AXIS, radius, segments
 plane = group.entities.add_face edgearray
```

```
plane.pushpull(one_year)
```

Active Year Extrusion Script

- **Call data from a specific location**

```
type = columns[0]

notes = columns[5]

link = columns[6]

image = columns[7]

movie = columns[8]
```

Type Data and Data Logger Column Reference

- **Shapes file path**

File location had to be defined for event associated shapes (components):

```
@shapes_path = "C:/Users/neld/Documents/Coding/Sketchup/Shapes/"
```

Shapes File Path

- **Associate the data with an object that represents that type of event**

Components had to be defined stating if [type] equals (“component file”) to be loaded:

```
#Load the components we need.

 @components[:Video] = loadComponent("Video2.skp")

 @components[:Audio] = loadComponent("Audio2.skp")

 @components[:Text]  = loadComponent("Text2.skp")

 @components[:Image] = loadComponent("Image2.skp")

 @components[:Cube]  = loadComponent("Comp_Vid_01.skp")
```

Event Object File Reference

- **Components had to be textured to represent a specific event or associated evidence**

```
#Setting materials up to be used as textures # Load the materials we need

 model = Sketchup.active_model

 materials = model.materials

 m0 = materials.add "Video"

 m1 = materials.add "Audio"

 m2 = materials.add "Image"

 m3 = materials.add "Text"

 m0.texture  = C:/Users/neld/Documents/Coding/Sketchup/Materials/Images/video2b.png"

 m1.texture = "C:/Users/neld/Documents/Coding/Sketchup/Materials/Images/audio2.png"

 m2.texture = "C:/Users/neld/Documents/Coding/Sketchup/Materials/Images/image2.png"

 m3.texture = "C:/Users/neld/Documents/Coding/Sketchup/Materials/Images/text2.png"
```

Adding Component Textures

- **Methodology of differential event types**

```
#Define the data read for the entity or component and tell what is to be drawn

   if type == "Timescale"

    drawTimescale start, duration, lat, long, notes, link, image, movie

   elsif type == "Cube"

    drawCube event, start, duration, lat, long, notes, link, image, movie

   elsif type == "Video"

    drawCube_vid event, start, duration, lat, long, notes, link, image, movie

   elsif type == "Audio"

    drawCube_aud event, start, duration, lat, long, notes, link, image, movie
```

```
elsif type == "Image"
 drawCube_img event, start, duration, lat, long, notes, link, image, movie
elsif type == "Text"
 #drawCube_txt event, start, duration, lat, long, notes, link, image, movie
```

<if> and <elsif> Event Type Arguments

- **Geoloc Event Type Script**

```
elsif type == "GeolocCity"
drawGeoloc_geolocCity event, start, duration, lat, long, notes, link, image, movie
elsif type == "GeolocCountry"
drawGeoloc_geolocCountry event, start, duration, lat, long, notes, link, image, movie
elsif type == "GeolocLatitude"
drawGeoloc_geolocLatitude event, start, duration, lat, long, notes, link, image, movie
elsif type == "GeolocLongitude"
drawGeoloc_geolocLongitude event, start, duration, lat, long, notes, link, image, movie
```

Geoloc Event Type Argument Script

- **Geo-Locating the model**

```
### Geo-locating the model
 model = Sketchup.active_model
 shadowinfo = model.shadow_info


#Geoloc Model
def drawGeoloc_geolocCity(event, start, duration, lat, long, notes, link, image, movie)
### Geo-locating the model - In City
puts("draw Geoloc start")#to signify the begining of the process
 model = Sketchup.active_model
```

```
 shadowinfo = model.shadow_info
  a1 = notes
shadowinfo["City"] = a1
puts shadowinfo ["City"]
 puts shadowinfo ["City"]#Repeat to make it visible in the Ruby Console
  puts shadowinfo ["City"]#Repeat to make it visible in the Ruby Console
end

def drawGeoloc_geolocCountry(event, start, duration, lat, long, notes, link, image, movie)
### Geo-locating the model - In Country
 model = Sketchup.active_model
 shadowinfo = model.shadow_info
  a2 = notes
shadowinfo["Country"] = a2
puts shadowinfo ["Country"]
 puts shadowinfo ["Country"]#Repeat to make it visible in the Ruby Console
  puts shadowinfo ["Country"]#Repeat to make it visible in the Ruby Console
end

def drawGeoloc_geolocLatitude(event, start, duration, lat, long, notes, link, image, movie)
### Geo-locating the model - At Latitude

 model = Sketchup.active_model
 shadowinfo = model.shadow_info
```

```
  a3 = notes
 shadowinfo["Latitude"] = a3.to_f #to_f for SketchUp to interpret the float (Descimal)
 puts shadowinfo ["Latitude"]
puts "draw Geloc_Lat end"
end


def drawGeoloc_geolocLongitude(event, start, duration, lat, long, notes, link, image, movie)
### Geo-locating the model - At Latitude
  model = Sketchup.active_model
  shadowinfo = model.shadow_info
   a4 = notes
 shadowinfo["Longitude"] = a4.to_f #to_f for SketchUp to interpret the float (Descimal)
 puts shadowinfo ["Longitude"]
puts "draw Geloc_Long end"
puts "drawGeoloc_City_Country_Lat_Long end"
end


# Receive return that the location is successful
  puts "Geo-locating model" #to signify the end of the process - the model will only locate
                        #once the *.csv file is run
```

Variable Geolocating the Model Script

- **Component library scripts**

Load the component to a library, calling a specific small model file in representation

```
@components[:Video] = loadComponent("Video2.skp")
```

Load Component Script

- **Using a helper function the component is loaded from file into a definition list**

```
# Helper function to load components from file into Definition List

   def loadComponent(name)

    #path=Sketchup.find_support_file name, "Components/Components Sampler/"

    model = Sketchup.active_model

    definitions = model.definitions

    path = @shapes_path + name

    componentdefinition = definitions.load path

    return componentdefinition

end
```

Load Component Script - Helper Script

- **Instruct the reading of data from the chosen *csv file, reading each row, and separating data by column. Each column is defined as data as is, data as float (*to_f) to retain the decimal value, or data as integer/whole number (*to_i)**

```
# Read the data from the file.

def readData

  puts("readData")

  file = File.new(@data_filename, 'r')



  file.each_line("\n") do |row|
```

```
  #puts('readLine')

   columns = row.split(",")



   type = columns[0]

   start_date = columns[1].to_i

   end_date = columns[2].to_i

   lat = columns[3].to_f

   long = columns[4].to_f

   notes = columns[5]

   link = columns[6]

   image = columns[7]

   movie = columns[8]
```

How to Read the Data Script

- **Provide a method of interpreting and representing all latitude and longitude data as an array (my code includes an option that can be switched on to represent these coordinates as Universal Transverse Mercator Coordinate System (UTM) if one should wish to do so)**

```
ll = [lat, long]

  latlong = Geom::LatLong.new(ll)

  ### Add the following 2 lines and block the last one <puts Latlong.to_a> if you want to use UTM

  #utm = latlong.to_utm

  #puts utm.to_a

  puts latlong.to_a
```

Latitude, Longitude Array with UTM Option Script

- **Provide amplification factors to accurately represent the values in the modelling**

```
#Provide amplification factors to the values

  start = start_date * 10 # (start_date - @active_date) * 10

  duration = (end_date - start_date) * 10

  event = type
```

Visual Representation Amplification Factor Script

- **Provide the variable statement argument <if>, <elsif> to identify a unique type of event**

```
elsif type == "Video"
   drawCube_vid event, start, duration, lat, long, notes, link, image, movie
```

Event Variable Statement Argument Script

- **Draw the unique event when called (in effect a model within the model)**

```
def drawCube_vid(event, start, duration, lat, long, notes, link, image, movie)

 # Draw a point in Brisbane Australia (-27.476595S or any, 153.027283E or any)

 lnglat_array = [long, lat, start]

 model = Sketchup.active_model

 #entities = model.entities

 point1 = model.latlong_to_point lnglat_array

 model.entities.add_cpoint(point1)



 model = Sketchup.active_model

 entities = model.entities

 duration = [duration, 1].max #Define the array of duration...no less than 1 if more then to the max

 stretch = duration #Define the terminology for duration "how much the stretch is"
```

```
 #start = start.m #- @active_date.cm



###Circular event disk

   center_point = point1

    radius = 20.m

    segments = 72



    group = entities.add_group

    edgearray = group.entities.add_circle center_point, Z_AXIS, radius, segments

    plane = group.entities.add_face edgearray

    plane.reverse!

### indicate the duration of the event

    plane.pushpull(stretch.m) #(start.m - @active_date)#(stretch)

### Use colour to identify the type of event at a glance

     mr = Sketchup.active_model.materials.add

     mr.color = "Aquamarine"

     group.material = mr

   puts ("draw vid event duration")
```

Event Draw Script

- **Enhance the event with an identification flag**

```
###Add a type component (the rich media flag) for identification

    transformation = Geom::Transformation.new point1

    componentDefinition = @components[:Video]
```

```
  instance = entities.add_instance(componentDefinition, transformation)
```

ID Type Flag for Attribution Script

- **Provide the optional Text identifier and URL linking functionality to enhance and make the model dynamic and rich in representation**

```
#Add Text

#text = entities.add_text notes, point

#Add a new text attribute

#Define a position for a construction point to hang the text - event name

#Attributes: Text - Type of event (What happened?)

 cpt_1 = Geom::Point3d.new(point1)



 constpoint = entities.add_cpoint cpt_1



#Add the Event name to the entity

 #model = Sketchup.active_model

 #entities = model.entities

#Switch the following on to see the event name

 #eventname_text = entities.add_text event, cpt_1



# Add a Dynamic attribute  - The Hyperlink to entity at cpt_a in this case a video tile

# Call the following function with your instance or entity to add

# the link

 if (! movie.nil? && movie != "")

   set_url(instance, movie)#This is the line where is chooses where to get the data from
```

```
  end
end


# Set the url to 'link' on the supplied instance.
def set_url(instance, movie)
  dict_name="link_data"
  dict_key_url = movie
  instance.attribute_dictionary(dict_name, true)
  instance.set_attribute(dict_name,"url",dict_key_url)
end


# Open the link (if there is one) in the users browser when they right click.
def url_open
  model=Sketchup.active_model
  e = model.selection[0]
  dict_name="movie_data"
  dicts=e.attribute_dictionaries
  if( (dicts != nil) and dicts[dict_name])
    dict_key_url = e.get_attribute("movie_data", "url")
    UI.openURL(dict_key_url)
   else
    UI.messagebox("No URL set for this " + e.typename.to_s)
end
```

```
# Add context menu item for opening links to the UI.

UI.add_context_menu_handler do |menu|

  menu.add_separator

  menu.add_item("Open URL")



end

  ##Add link to a document or web event in suport of or about the entity(Event)

   ##Add link to an image in support of or about the entity(Event)



puts("draw Video")

end
```

Attribution Elements Script

Appendix D – CIF ERA 2012 Scores

ERA 2012 CIF ratings for 12, 19 & 20 F.O.R. Codes

12	**Built Environment and Design**	**3**
1201	Architecture	3
1202	Building	3
1203	Design Practice and Management	3
1204	Engineering Design	Not Assessed
1205	Urban and Regional Planning	2
1299	Other Built Environment and Design	Not Assessed
19	**Studies In Creative Arts and Writing**	**4**
1901	Art Theory and Criticism	Not Assessed
1902	Film, Television and Digital Media	4
1903	Journalism and Professional Writing	4
1904	Performing Arts and Creative Writing	3
1905	Visual Arts and Crafts	3
1999	Other Studies In Creative Arts and Writing	Not Assessed
20	**Language, Communication and Culture**	**5**
2001	Communication and Media Studies	5
2002	Cultural Studies	4

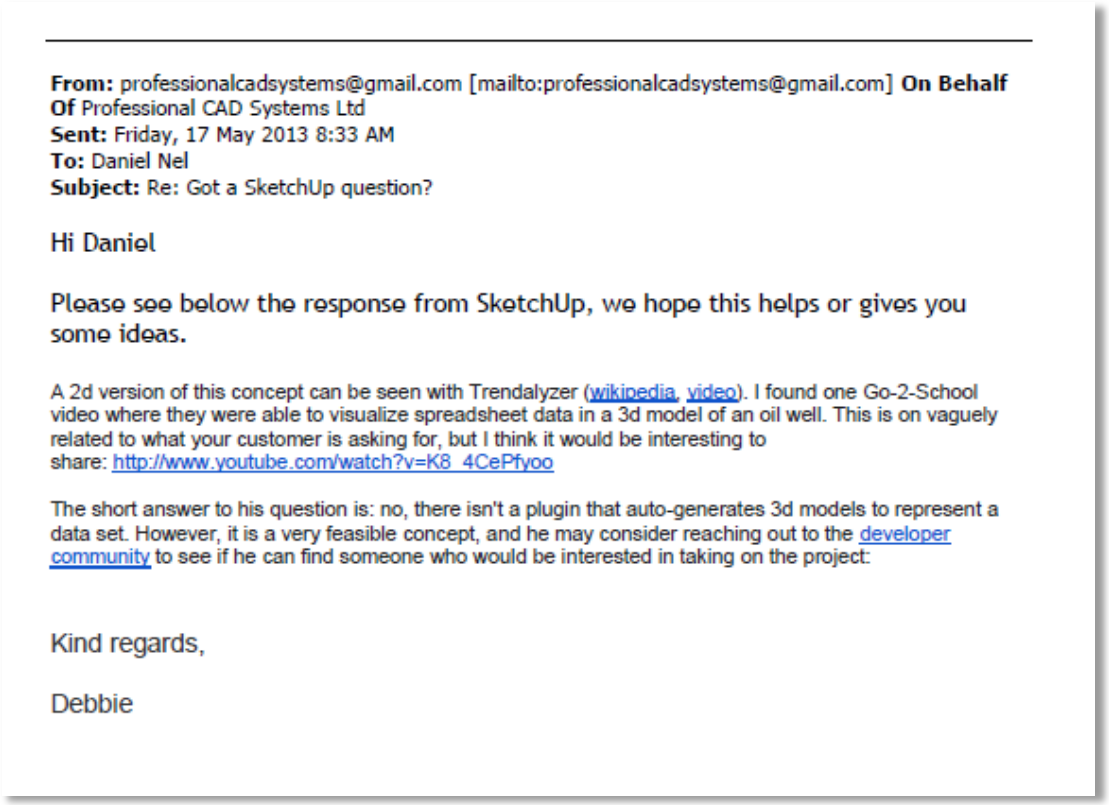
(Australian Government 2012)

Australian Government, Australian Research Council. 2012. "University Results, ERA ratings for the Queensland University of Technology." http://www.arc.gov.au/era/outcomes_2012/Institution/QUT.

Appendix E – email confirming feasibility

On P.65, para 1 I wrote:

"…Both the location and the date are converted to a standardised numeric format. By doing so I could locate a single intersection point of the x, y and z-axis for the positioning of event-related data. The validity of this concept was confirmed in discussions with the software vendor on how the model might be auto-populated. The vendor had discussions with the creators as to the veracity of such an approach. The outcome of these discussions was an e-mail verification of my approach in the following words: "It is a very feasible concept"…"



From: professionalcadsystems@gmail.com [mailto:professionalcadsystems@gmail.com] **On Behalf Of** Professional CAD Systems Ltd
Sent: Friday, 17 May 2013 8:33 AM
To: Daniel Nel
Subject: Re: Got a SketchUp question?

Hi Daniel

Please see below the response from SketchUp, we hope this helps or gives you some ideas.

A 2d version of this concept can be seen with Trendalyzer (wikipedia, video). I found one Go-2-School video where they were able to visualize spreadsheet data in a 3d model of an oil well. This is on vaguely related to what your customer is asking for, but I think it would be interesting to share: http://www.youtube.com/watch?v=K8_4CePfyoo

The short answer to his question is: no, there isn't a plugin that auto-generates 3d models to represent a data set. However, it is a very feasible concept, and he may consider reaching out to the developer community to see if he can find someone who would be interested in taking on the project:

Kind regards,

Debbie